

ENGINEERING'S REPORT FOR:

PROPOSED IMPROVEMENTS
ORTON SLOUGH DRAINAGE DISTRICT

WOODBURY COUNTY, IOWA

9/30/2014
Project No. 14-16118



I+S GROUP

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FOR
ORTON SLOUGH DRAINAGE DISTRICT
WOODBURY COUNTY, IOWA

PROJECT NO. 14-16118

	<p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p> <hr/> <p>Ivan D. Droessler, P.E. Date</p> <p>License No.: 11837</p> <p>My License Renewal Date is December 31, 2015</p>
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**ENGINEER'S REPORT
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ORTON SLOUGH DRAINAGE DISTRICT
WOODBURY COUNTY, IOWA
2014**

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**ENGINEER'S REPORT
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1.0 INTRODUCTION

1.1 Scope of Work

The purpose of this report is to provide information relative to drainage relief requested by landowners within the benefited drainage area of the Orton Slough Drainage District, Woodbury County, Iowa.

Based on landowners concern with poor drainage after heavy rain events in the spring of 2010, the County Engineer recommended the Board of Supervisors hire a consultant to evaluate the capacity of the existing tile outlet and recommend improvements. The Board of Supervisors directed the County Engineer prepare a request for proposals and assist them in the selection of an Engineer. In October of 2013, the Board of Supervisors, acting as Trustees for the Orton Slough District hired/appointed I+S Group as Drainage Engineer to complete the necessary investigation, study, and report for proposed improvements to the Orton Slough.

1.2 Location & Description

The Orton Slough Drainage District includes 2,760 acres of mostly agricultural lands between Browns Lake and the City of Sergeant Bluff. The watershed is within Sections 5, 8, 9, 16, 17, 20 and 21 of Liberty Township (T87N, R47W), Woodbury County, Iowa.

This watershed is located in the Missouri River Valley on the old flood plain of the river. The soils are in the Albaton-Haynie-Onawa association described as level or nearly level, stratified, clayey and silty soils that are well drained to poorly drained. The natural slope of the land is between 0.03% to 0.04%. The natural drainage is from the north to south toward Browns Lake an oxbow lake of the old Missouri River.

The District established to provide an improved outlet to these lands draining to the natural outlet, Browns Lake.

1.3 District Facilities

The outlet for this District is a 24 inch tile main which outlets into the Browns Lake in the SE1/4 of NW1/4 of Section 18-87-47. The tile main then extends northerly for 6,785 linear feet to the south line of the NE1/4 – NW1/4 of Section 21-87-47.

1.4 History Outline

A petition was filed for the establishment of a District in 1912 to provide surface drainage relief to this watershed. The open ditch was rejected by the landowners and the installation of a 24 inch tile outlet was approved. An outline of the history follows:

- | | |
|------------|---|
| 1912 | Original petition for the establishment of the Drainage District. |
| 7-3-1912 | Louis Godfredson requests his name be removed from the original petition. |
| 1919 | Objection to establishment of ditch and laterals. |
| 6-30-1919 | Board passed and approved the plans and profile submitted by the Engineer on 6-11-1919. |
| 11-1919 | A proposed ditch and drainage district with plats and profiles were filed with the County Auditor. |
| 5-04-1920 | Specifications for the installation: 6,785 LF of either 24" Clay or Cement, 24" Galvanized Outlet Pipe and both a 24" intake and 18" intake. Completion Date 8-1-1920. |
| 5-14-1920 | Repair of tile: \$225.00 5 LF of 24" galvanized outlet pipe. |
| 1-11-1921 | Contract for 6,785 LF of 24" @ \$1.16/LF. Concrete tile slope of 24" tile is 0.75" per 100 LF (0.0625%). |
| 12-21-1942 | Engineer recommended 1% levy producing \$161.10 |
| 11-13-1952 | County Engineer reported the need for a partial clean-out of the ditch @ a cost of \$1,445. Original cost of District reported to be \$16,109.00. Also recommends a 10% levy. |

- 3-11-1964 IDOT, at the time Iowa State Highway Commission, signed an agreement for classification of the primary roads within the District (I-29 & US Highway 75) since they had never been assessed.
- 1-3-1984 Agreement between District and IBP to allow agricultural land owned by IBP to drain into the District; that part of the NE1/4 lying southwest of I-29, Section 28-87-47. Involves 75 acres more or less at a \$1,000.00 payment + \$100 annual assessment commencing Sept. 1985 as long as the ground is committed to agricultural.
- 6-3-1985 Letter from the Board to Landowner Hollenbeck – The Board terminates the agreement between the Drainage District & IBP.
- 6-17-1985 Petition for cleanout filed by Fred L. Godfredson
- 11-15-1985 Engineer's report for cleanout and improvements of the Northeast ditch within the Orton Slough Drainage District. County Engineer states that in 1920 a 24" tile was installed through west 1/2 of Section 21 & 28, T87N, R47W with two open ditches discharging into Tile Main in the SE1/4 of NW1/4 of Section 21.
- 11-18-1985 Public hearing held on engineer's report.
- 12-2-1985 Public hearing on engineer's report for cleanout repair with improvements was held, no objections from landowners present. Engineer Report was approved. Bids to be received January 27, 1986.
- 1986 Handwritten notes in district file: Petition filed by landowner to "cleanout ditch" starting from the railroad tracks, ditch not only needs cleaning but pipe through railroad and US Highway 75 need to be lowered for lands across County Road D-51 to properly drain. Could not find original grades and cross sections but the District has a duty to maintain their facilities. Iowa Department of Transportation to pay for road crossings.
- 6-23-1986 Letters from Ray Johnson of Johnson's Farm Management Service, feels the driveway culvert located N1/2-NW1/4 Sec 21, T87N, R48-47W has been blocked with timbers and soil blocking surface drainage.
- 7-14-1986 Board approved plans and specification for cleanout and with such improvements as may be necessary.

- 7-15-1986 Commissioners report on reclassification filed for a small area of the watershed rezoned from agricultural to industrial use.
- 9-15-1986 Hearing on the Report of Commissioners of the Orton Slough Drainage District.
- 11-10-1986 Board authorizes through resolution issuance of stamped warrants, fixing the rate of interest and spreading assessment over 3 years.
- 11-10-1986 Bid letting 3 bidders with contract awarded to low bidder @ \$16,700 KW Boring of Papillion, NE.
- 12-1-1986 Agreement between District and railroad which allows District to make repairs to their facility within Railroad right-of-way at District's cost.
- 12-12-1986 Contract to cleanout 0.743 miles of ditch within the Orton Slough Drainage Ditch; items on contract:
1. Class 10 Channel Excavation - Approx. 151 CY from Sta. 0+00 - 6+53.
 2. Approx. 610 CY - Sta. 6+53- 40+23.
 3. Remove and Relay 24" Dia. CM culvert pipe 60 LF.
 4. Furnish and place 30" Dia. steel casing culvert pipe through railroad bed Sta. 35+92 60 LF
 5. Furnish and place 30" Dia. steel casing culvert pipe through highway 75 LF of 36".
 6. Clearing and Grubbing.
- TOTAL OF CONTRACT = \$16,700.00
- 1-19-1987 Certificate of Completion of 1986 cleanout work - Channel excavation located in SE 1/4 of the NW1/4, and the S1/4 of the NE1/4, NE1/4, Sec. 21, Liberty Township.
- 2-23-1987 Completion Report filed.
- 4-7-1987 Landowner request for additional capacity because of slow flow of water.

- 4-23-1987 Engineer Virtue filled comments regarding the repairs to the district, assessment to the lands within the watershed, and what effects the improvements have had. Original assessment of the district is included with this submittal. However, it was not possible to obtain a copy.
- FALL 1987 Lawsuit over culvert installed as part of the improvement project.
- 6-20-1988 Set levy for 1986 Reports with improvements \$20,586.16.
- 1-04-1994 Orton Slough Drainage District paid \$276.00 to Hopkins Contracting Inc. for exploratory digging to locate broken field tile on Dennis Broulette farm.
- 11-06-1996 Report for replacement of outlet pipe for Orton Slough \$3,870.00.
- 2-14-1997 Letter from John T. Hall requesting to cleanout the east road ditch of Barker Ave (west side Sec. 16, Liberty Twp.)
- 10-09-1997 Letter received from Duane Hughes to Board member Mr. Burnight concerning assessments.
- 10-16-1997 Request for reclassification by landowner Mr. Duane Hughes from County Engineer to Engineer Virtue.
- 6-09-1998 Resolution #9087 Design Homes, Inc. constructed a manufacturing building with adjacent concrete parking lot. Reclassification of parcel was authorized.
- 11-03-1998 Tentative approval of reclassification of certain tracts of lands in Section 21, T87, R47 at public hearing held Dec. 22, 1998.
- 7-18-2000 Public hearing held on cleanout of east road ditch of Barker Ave. Section 15, Liberty Township. Landowner through Family Partnership pays for deepening approx. 3000 LF from 1' to 4'.
- 7-25-2000 Request of landowner, John Hall, to cleanout the east road ditch of Barker Ave. was approved by the Board of Supervisors in Sec. 16 Liberty Twp.

2.0 FIELD INVESTIGATION

2.1 Investigation

In summer of 2013, the County Engineer's Staff performed a topographic survey of the watershed with profile shots along the alignment of the District Tile Main. The survey included elevations sufficient to tie the survey datum back to the original elevations established when the Tile Main was constructed. The existing 24 inch diameter tile outlets into Browns Lake at an elevation 1.0 feet above the outlet weir elevation of Browns Lake. The tile was then to traverse northerly on a 0.0625% grade for approximately 6,785 feet.

From the profile survey data the existing gradeline is as follows:

EXSITING GRADELINE:

BEGIN STATION	END STATION	TILE SIZE	SLOPE
0+00	23+94	24	0.1%
23+94	25+14	24	0.033%
25+14	38+63	24	0.033%
38+63	59+04	24	0.054%
59+04	67+85	24	0.054%

Typically on the Missouri River bottom, drainage is provided by means of surface channels and open ditches for tile outlets are rarely available. These facilities are typically designed to remove approximately 1 inch of runoff from the lands in the watershed in a 24 hour period. For watersheds without surface drainage relief using subsurface tile system as their outlet, agricultural drainage standards recommend the outlet be capable of handling ½ inch runoff per acre per 24 hour period. Based on the existing gradeline of the Tile Main we computed the capacity of the tile and found the tile to only have from 10 to 17 percent of the capacity recommended for good agricultural drainage.

In addition to the capacity of the outlet, we also evaluated the surface drainage system of the watershed. The watershed is subdivided by I-29, old Highway No. 75 and the Union Pacific (UP) railroad traversing from northwest to southeast across the watershed. The northern 1,800 acres drain by surface with approximately 1,100 acres following a natural drainage swale along the west side of the Orton Slough watershed through sections 9, 16, 15 and 21. This swale drains through culverts under Benton Ave, County Road D-51, old Hwy 75, and the UP Railroad and ponds in the natural low slough area in the SE1/4 of NW1/4

of Section 21. The other 700 acres in the central and westerly portions of the watershed drain south to this same low area by means of the road ditches of Barker Ave and I-29.

The conveyance of drainage from the 1,100 acres was improved in 1986, after a petition was filed asking for a cleanout of the existing shallow open ditch that traverses from the drop riser of the tile main in the SE1/4 NW1/4 of Section 21, easterly to the culverts through the UP Railroad and Old US Highway 75 in the NE1/4 NE1/4 of Section 21. In addition, the culverts under the railroad and Old US Highway 75 were lowered to provide better drainage to the lands north of County Highway D-51. There is no record of this channel being part of the original construction of this District.

The conveyance of drainage along Barker Ave was improved privately by John Hall in 1997 when he paid for the clean out of the east road ditch of Barker Avenue along his property in Section 16 of Liberty Township.

2.2 Findings

The natural slope of this watershed is very flat and the surface drainage for the northerly portion of this watershed is by natural swales or road ditches, neither of which has been significantly improved. Therefore, the time of concentration to the tile outlet is slow. However, when the drainage does reach the SE1/4 of the NW1/4, Section 21, the drainage ponds because the tile outlet only has 1/10 of the capacity necessary for good agricultural drainage. Once the water ponds in this natural low area, the flooding backs up the existing drainage swales and road ditches causing additional ponding further up in the watershed. Therefore, for the District to provide drainage relief to these lands, the outlet system starting at Browns Lake needs to be improved. Therefore, we evaluated three (3) options for improving the capacity of the outlet along with preliminary cost estimates for each.

Improvement Option No. 1 is to install a parallel tile to the existing District line. The system would be cross tied to work in combination to provide the recommended ½ inch drainage coefficient. Improvement Option No. 2 would replace the existing tile main with a new tile facility on a new alignment, and provide the entire ½ inch drainage coefficient. Improvement Option No. 3 is to excavate an open ditch to replace the tile main outlet (on the same alignment of the replacement tile of Option No. 2). We also evaluated an Option No. 3A, which would provide for a lateral open ditch parallel on the east side of I-29 extending northwest into Section 16 as to provide a direct outlet for drainage along Barker Avenue and the discharge from the lands west of I-29. Please refer

to Sheet A.04 for a map relating the alignments of the options and to Exhibit A for the cost estimates for these different options.

2.3 Informal Hearings

After our preliminary evaluation of the improvement options we recommended the Board hold an informal public hearing with the landowners of the District to inform them of the options and construction costs and to receive input from the landowners as to their desires.

On January 16, 2014, the first informal hearing was held in the Community Room in Salix, Iowa. Landowners in the Orton Slough and residents of unincorporated area of Browns Lake were in attendance. Concerns about the impact of an open ditch outlet facility were expressed by Landowners that live along and use Browns' Lake for recreation. Discussion of the proposed improvements and the impact they would have on water quality were held. The largest concerns were expressed about the open ditch option for Browns Lake landowners assumed more sediment would be delivered to the Lake with this option. We explained that over 1,100 acres of the watershed drain through a vegetated parcel currently enrolled in the Conservation Reserve Program (CRP). This parcel will provide filtering of suspended soil particles. Also, it was explained that due to the flat topographic conditions of the watershed soil erosion on the agricultural lands were generally below allowable soil loss figures tracked by the Natural Resources Conservation Service.

After the hearing it was apparent that the open ditch was the preferred option of the landowners in the District due to cost. Therefore, the Board acting as Trustees of the District requested we evaluate additional measures to enhance the control of sediment from this watershed to address the concerns of the open ditch option. Enhancement of the natural detention of the 20 acre CRP parcel was evaluated by means of removal of the current tile inlet and the installation of a two stage inlet that uses infiltration for drainage of the temporary stored runoff. A subsurface inlet would be installed and outlet to the new ditch by subsurface piping to drawdown the stored runoff through the soil profile which will filter suspended solids out.

In addition to the detention/infiltration basin practice, the use of in channel rock riffle barriers to form sediment traps at 600 foot intervals was proposed. The lower 4,800 feet of channel below the basin will incorporate these traps reducing the amount of sediment being delivered to Browns Lake. As the sediment traps fill, they can be excavated to reestablish their trapping efficiency.

The Board then held an additional informal hearing on June 4, 2014 again in the Community Room in Salix, Iowa to discuss the recommended open ditch improvement option along with the water quality measures recommended to be incorporated as part of the District's project. The Board again heard concerns by Browns Lake landowners about water quality. In addition, the Board heard support by the Orton Slough Landowners for drainage relief due to the inadequate sized District Outlet.

On July 8, 2014, the Board directed the Engineer to proceed with a formal report with notice to be provided to all landowners in the Orton Slough District for a public hearing to be schedule after filing of the report.

3.0 RECOMMENDED OPEN DITCH OPTION

3.1 Open Ditch Design

Based on our investigation and cost of the tile improvement options, we find the open ditch option to be the most cost effective means of providing drainage relief to the landowners in the District. In addition, the open ditch provides for larger storm capacity due to the depth of the ditch to provide the gradeline necessary to serve the district. This is important in this watershed for there is already commercial development occurring along 260th Street and there is the potential with the CF Industries, Inc. expansion of their Port Neal Plant of additional development along this road between County Road K25 and the interchange of I-29.

The capacity of the open ditch was computed to provide a minimum of a $\frac{3}{4}$ " drainage coefficient from the entire watershed. The gradeline of the ditch is set based on providing an adequate depth of outlet for the natural low slough area in the SE1/4 NW1/4 of Section 21. The outlet of the ditch is set one (1) foot above normal pool elevation of Browns Lake. From these design parameters, the bottom width of the ditch was determined. Based on the soils, the sideslopes of the open ditch are planned to be 2:1. However, due to the history of open ditches on the Missouri River Flood Plain having unstable slopes in deeper cut areas, we would recommend if this open ditch project is approved that a geotechnical investigation be completed on the lower 4,800 feet of open ditch to verify the stability of 2:1 sideslopes. The depth of ditch along this reach averages over 10 feet.

3.2 Water Quality Measures

As discussed in Section 2.3 of this report, after the informal hearing in January the Board, acting as Trustees of the District, requested we evaluate additional measures to enhance the control of sediment from this watershed to address the water quality concerns of the open ditch option. Our preliminary design includes proposed enhancements to natural detention of the existing CRP land in the N1/2 of the SE1/4 NW1/4, Section 21. The current tile outlet would be removed with the tile end capped just south of this property. Instead a two stage inlet that uses infiltration for drainage of the temporary stored runoff would be constructed. The subsurface inlet would be constructed of perforated storm water detention chambers installed with aggregate backfill to draw the surface water through a shallow soil profile into the storm chambers. These chambers would be piped to outlet into the new open ditch. During large flows, a drop riser would provide an overflow outlet for the surface water piped directly to the open ditch. See details on Sheet A.05 of the preliminary plans.

In addition to the detention/infiltration basin practice, sediment would be further controlled by the use of in-channel rock riffle barriers to form sediment traps at a 600 foot intervals between the outlet of the ditch and I-29 or the lower 4,800 feet of channel. To form these traps the gradeline of the open ditch would be undercut by 0.5 feet and then riprap placed across the width of the ditch, 18 inch in depth to form the riffles. Surface flows would be slowed behind these riffles with sediment settling out in these traps. As the sediment traps fill, they can be excavated to reestablish their trapping efficiency. The riprap will allow for the shallow pooled water in the traps to slowly drain away through the porous rock. Again details are given on Sheet A.05 of the preliminary plans.

3.3 Alignment & Road Crossings

The proposed alignment of the open ditch (See Sheet A.04) was chosen parallel to property lines or 1/4-1/4 Section lines to avoid point rows and severance of developable lands along 260th Street. The main open ditch will extend to the north side of the CRP land in the N1/2 of the SE1/4 NW1/4, Section 21. In addition, the alignment of Lateral No. 1 proposed as Option 3A will parallel the right-of-way of I-29 and will provide for direct drainage of this segment of I-29.

The proposed alignment will traverse County Road D-51 (260th St.) and I-29. Iowa Law (code section 468.108) requires that the costs of crossing county and state roadways with drainage district facilities be paid from the appropriate road

funds. The clear evident purpose of the statute is to remove the roadways as potential impediments to the construction of the most efficient drainage collection system for the landowners.

We have computed the minimum size of culvert necessary to meet the District's needs with that being a circular 60 inch. Due to both roadways being paved, the cost estimates are based on reinforced concrete pipe and trenchless installation. The final design decision for the ditch crossings of the roadways is the responsibility of the Woodbury County Engineer and Iowa Department of Transportation (IDOT).

The Woodbury County Engineer and IDOT may choose to separately contract the crossing work. If the work is to be included with the District project, the plans and specifications are to be prepared by the respective entity with the District reimbursed for the cost of construction by the County Secondary Roads and the IDOT when the work is completed.

3.4 Other Crossings

There are no railroad or entrance crossings associated with the proposed open ditch alignment. We have also evaluated access to fields along this route and find no need for any private crossings for access is available from public roadways.

3.5 Fence

There are fences along both D-51 and I-29 that will require fence cuts to accommodate the proposed open ditch. These costs are included in our estimate.

3.6 Utilities

There are several utilities that will be traversed by the proposed open ditch alignment. Starting at Browns Lake, there is a Northern Natural Gas Pipeline approximately within the first 300 feet that will need to be lowered. The alignment will then traverse under a high power transmission line in the NW1/4 NW1/4, Section 28. The clearance under the power lines from the top of spoil bank will need to be verified with notification provided to the power company. Once the alignment reaches D-51, there are both overhead power and buried phone lines in the north ditch to be address.

Under Section 468.186(2) of the Iowa Drainage Code it discusses when an existing District is making repairs or improvements to its facilities as follows: "If

the drainage or levee district subsequently undertakes any maintenance, improvement, or reconstruction of its facility which requires the modification, relocation, or reconstruction of the installation, the expense of such modification, relocation, or reconstruction shall be borne by the person who constructed the installation or the person's successors in interest.

Since the open ditch does not follow the existing tile alignment, we recommend legal counsel be consulted to determine if subsection 2 of this code section does apply.

In all cases, during construction the contractor will be responsible to determine and notify utility companies and to cooperate in locating, marking and protecting their facilities.

3.7 District Right-of-Way

The improvement Option 3 and 3A will require the acquisition of right-of-way from the landowners traversed since these two options include the excavation of a new drainage ditch. This will require the taking of lands in the excavation from agricultural production and is estimated at 11.31 acres for the Main Open Ditch and 4.42 acres for Lateral No. 1.

In addition, on each side along the actual top of ditch the District will need additional easement for ingress and egress for the construction and maintenance of the improved open ditch. The landowners retain ownership and use of these easement acres for farming with these lands intended to be removed from the property tax rolls. However, the District's access must remain unblocked and the District does not have to pay crop damages for future repairs or improvements. The spoil from the open ditch excavation will be placed as a spoil berm along the ditch after stripping the top soil and temporarily stockpiled. Once the spoil is shaped the spoil berm will be top soiled with the strippings. Easement to approximately 4.15 acres for the Main and 2.26 acres for Lateral No. 1 will be required. The following table provides information regarding the proposed right-of-way to acquire.

OPTION 3, MAIN OPEN DITCH

1/4 - 1/4	SEC-TWP-RNG	BEGIN STA	END STA	EXISTING ROW, AC	TAKEN ROW TO ACQUIRE, AC	EASEMENT ROW TO ACQUIRE, AC
SW-NW	28-87-47	0+00	9+01	0.00	1.65	0.53
NW-NW	28-87-47	9+01	24+11	0.00	2.76	0.89
SW-SW	21-87-47	25+50	38+04	0.00	2.14	0.73
NW-SW	21-87-47	38+04	49+00	0.00	2.32	0.77
NE-SW	21-87-47	52+53	54+16	0.00	0.23	0.14
SE-NW	21-87-47	54+16	57+04	0.00	0.40	0.26
SW-NW	21-87-47	57+04	67+85	0.00	1.69	0.69
NW-NW	21-87-47	67+85	68+60	0.00	0.12	0.14
				TOTAL=	11.31	4.15

OPTION 3A, LATERAL NO. 1

1/4 - 1/4	SEC-TWP-RNG	BEGIN STA	END STA	EXISTING ROW, AC	TAKEN ROW TO ACQUIRE, AC	EASEMENT ROW TO ACQUIRE, AC
SW-NW	21-87-47	0+00	10+77	0.00	1.64	0.68
NW-NW	21-87-47	10+77	24+85	0.00	2.11	1.21
SW-SW	16-87-47	25+35	29+28	0.00	0.67	0.37
				TOTAL=	4.42	2.26

The recommended easement will provide a 100 foot right-of-way width centered on the centerline of the ditch and provide room for unimpaired access along the open ditch for future maintenance work.

3.8 Work Area

The permanent right-of-way is not intended to be wide enough to accommodate construction activities associated with major repairs or improvements. The District will need additional work area adjacent to the right-of-way within which to properly shape the spoil bank. These acres will be included for stripping and topsoiling. The work limits will be 100 feet each side of centerline of the open ditch except where limited by road right-of-way. Landowners will also be entitled to compensation for crop damages in the work area outside the right-of-way. Within the permanent right-of-way, future construction-related damages will not be compensated. Compensation for use of and damages within the temporary work area is normally determined at the end of construction and with claims for damages reviewed and approved at the project completion hearing.

4.0 PROPOSED WORK

The analysis of the tile system confirms additional capacity is required in order to provide the watershed with good agricultural drainage. Therefore we propose the construction of the Main Open Ditch and Lateral No. 1.

4.1 Proposed Main Open Ditch & Lateral Construction

The proposed construction of the Main Open Ditch will begin at the outlet into Browns Lake and continue for 6,860 linear feet (Station 68+60). The work involves stripping the top soil from approximately 25.3 acres and excavating 59,319 cubic yards of material for an average of approximately 8.7 cubic yards per lineal foot of open ditch. The proposed Lateral No. 1 will begin at Station 54+20 on the Main Open Ditch and continue parallel to the right-of-way of I-29 for 2,994 linear feet (Station 29+94). This work involves stripping top soil from approximately 10.3 acres and 12,139 cubic yards of excavated material for an average of approximately 4.1 cubic yards per lineal foot.

The design dimensions of the Main Open Ditch and Lateral No. 1 are identical, that being a six (6) foot bottom and 2 to 1 side slopes. The spoil is to be deposited along both sides for the open ditch as indicated on the cross section sheets of the plans (Sheets X.01-X.07). The spoil bank on the field side will be leveled at a 10 to 1 slope away from the ditch to accommodate farming operations. Please note that spoil banks along the ditch are necessary for controlling surface water and farmers are encouraged to help maintain these banks.

Surface drainage pipes are planned to be installed along the entire length of the proposed open ditch. Approximately 440 linear feet of surface pipe is proposed to be installed.

Other miscellaneous work items involved are 400 linear feet of fence running perpendicular to the open ditch will need to be removed. Fence damages within the work limits can be claimed at the completion of the project. Fence owners are encouraged to remove their own fences where it is necessary to do so, especially where they wish to salvage part of the materials. The Contractor will also be required to fertilize and seed the excavated ditch banks. Experience has shown that seeding the open ditch provides for faster vegetation of the exposed slopes, which reduces erosion and noxious weed growth. Broadcasting the fertilizer and seed at the end of each day's excavation is the best way to secure a good germination of the seed; however, establishment of the seeding will still be difficult and largely dependent upon the weather.

Please refer to Exhibit A of this report for an estimate of the construction cost along with other potential project costs for Improvement Options 1 through 3A. The estimates represent the Engineer's best opinion of the probable cost of completing the proposed improvement. This opinion is based on our experience with similar projects. The quantities and unit costs are believed to be reasonably accurate for the purpose of this report and are conservative. However, no guarantee of the accuracy is made nor is it implied.

4.2 Water Quality Improvement Measures

In combination with the open ditch construction additional water quality measures are proposed in order to enhance the control of sediment from the watershed. These controls are not necessary under drainage law, but would reduce potential impact to Browns Lake. Our preliminary design uses a two-stage inlet that uses infiltration for drainage of the natural storage of the CRP lands in the N1/2 of the SE1/4 NW1/4, Section 21. The current tile outlet would be removed with the tile end capped just south of this property. The subsurface inlet would be constructed by the installation of three (3) rows of perforated storm water detention chambers. The work involves the installation of 240 linear feet of chambers, approximately 156 cubic yards of excavation, 128 tons of aggregate, and 1,465 square yards of geotextile fabric. In addition, 6 feet of 60" diameter RCP will be installed as a drop riser to function as an intake during large rain events. This new inlet system would outlet to the new open ditch by means of 700 linear feet of 36" diameter of dual wall plastic pipe.

Rock riffle barriers to form sediment traps are also proposed in the channel below I-29, and would be installed at 600 foot intervals from Station 0+00 through Station 48+00. These rock riffles will include approximately 36 tons of riprap and 1,422 cubic yards of excavation.

5.0 ANNEXATION & RECLASSIFICATION REVIEW

5.1 Annexation Evaluation

As part of our field investigation we have mapped the watershed boundary of this District using LiDAR (Light Detection and Ranging) data, aerial photography, soils and topographic maps to determine the lands that drain by surface or subsurface into the District. From this review it became apparent that there are several areas draining to the Orton Slough Drainage District that are not included in the current assessment boundary of the District.

We have computed that there are approximately 748 acres of land with adjoining road right-of-way in 40 parcels to be within the natural watershed boundary that

are benefited by the tile facility of the Orton Slough Drainage District but never were included for benefit. These lands are shown on Sheet A.02 of the plans.

In the northern portion of the watershed there are approximately 393 acres proposed to be annexed. Drainage flow modeling incorporating existing culvert information from the County Engineer's Office showed these acres drain through existing culverts under the UP Railroad and K-45 (Old Highway 75) while utilizing an existing drainage swale, and enter the facility at the drop riser structure in Section 21, Liberty Township. This ground is very flat and the soil survey information states that the majority of the soils are defined as well, to moderately well drained. It would be expected that the amount of benefit these lands receive from the facilities of this District would be very low. However, the area would still benefit from the ability to cast surface flows onto the lower elevations within the watershed. The determination of the amount of drainage benefit would be calculated as part of the reclassification proceedings.

An additional area of annexation is in the southern portion of the watershed. This area currently surface flow to existing intakes in the road ditch along 260th Street. This area is comprised of approximately 321 acres.

Section 468.119 of the Iowa Code states "...if the Board becomes convinced that additional lands contiguous to the district, and without regard to county boundaries, are benefited by the improvement to said district as contemplated in Section 468.126, board may adopt with or without a petition from owners of the proposed annexed lands, a resolution of necessity for annexation of such additional land."

We recommend that the Board adopt a Resolution of Necessity and order annexation of these lands that are not currently being assessed, but drain to the Orton Slough Drainage District. The cost of the annexation is estimated at \$2,000. It would be cost effective to do this annexation as part of the proposed project. Most landowners now in the Drainage District would likely support the annexation; those being annexed would tend to be opposed. It should be emphasized to the owners of the annexed lands that assessments are based upon relative benefits and that if this benefit is small, the assessment is also relatively small. In addition, the acres of annexation discussed in this report are preliminary. A final evaluation, a separate annexation report, and public hearing with formal notice are required.

5.2 Assessment Schedule Evaluation

The Orton Slough Drainage District's assessment schedule is based on a distribution of benefits development in 1921. Since then there has been land use changes in the watershed which would have affected the distribution of drainage benefits. Additionally, if the open ditch improvement is approved, the new alignment will change benefit factors applied to all of the lands in the watershed. In addition, if the recommended annexation is approved without construction of the improvement, over 748 acres of land will still need to be classified and added to this schedule.

Therefore, if any of the improvement options are approved for construction we would recommend the Board order reclassification of the Orton Slough Drainage District to redistribute the benefits to all the lands within the watershed for the Main Open Ditch and separately for Lateral No. 1. Additionally, if the open ditch option is approved, a separate maintenance schedule for the remaining tile main would also be necessary. The reclassification costs for the new main open ditch and lateral is estimated at approximately \$6 per assessed acre with the total acres of both schedules being approximately 3,760 for a total cost of \$22,560. In addition, approximately 150 acres would remain having benefit from the existing tile with the cost of a separate maintenance schedule estimate at \$1,500.

6.0 DISCUSSION & RECOMMENDATIONS

6.1 General

Based on the evaluation of the existing tile outlet it is apparent that there is a need for improved outlet capacity to provide drainage relief to the agricultural lands in Sections 5, 8, 9, 15, 16, 17, 20, 21, 28 and 29, Liberty Township, Woodbury County. After evaluation of the relief options; a parallel relief tile, installation of the replacement tile line, or the excavation of an open ditch, the open ditch options provide the most cost effective solution for this drainage relief. In addition, the open ditch also provides additional capacity for management of storm water from commercial developments that is starting to occur between Port Neal and I-29. With incorporation of the proposed sediment control measures, the water quality of Browns Lake will be protected while providing the improved drainage needed for improved agricultural production.

We further are recommending that the existing tile outlet be maintained until such time that the tile material is failing. Then we would recommend any existing private tile connected to this main be extended to the open ditch at a cost shared by the landowner and the District on equal basis.

6.2 Jurisdictional Wetlands

The USDA Farm Program has long included wetland conservation compliance “swampbuster” provisions administrated by the Natural Resources Conservation Service (NRCS). These rules and policies require that the lost functions, values and area of each converted (better drained) farmed wetland be replaced (mitigated). Under Part 12 of Title 7 of the Federal Regulations, “activities of a Water Resource District, Drainage District, or similar entity will be attributed to all persons within the jurisdiction of the District or other entity who are assessed for the activities of the district or entity. Accordingly, where a person’s wetland is converted due to the actions of the district or entity, the person shall be considered to have caused or permitted the drainage.” However, Drainage Districts in Iowa have the right to maintain the existing drainage capacity of their facilities. Therefore, under a repair option the only wetlands that could be affected would be wetlands or farmed wetlands located adjacent to the open ditch that may have spoil placed in them during the excavation of the open ditch. This situation can be avoided.

The US Army Corps of Engineer (USACE) in conjunction with the US Environmental Protection Agency (USEPA) also have jurisdiction to wetlands under the Federal Clean Water Act Section 404. However, for the wetlands to be jurisdictional they have to be connected to waters of the United States and not isolated wetlands. To be connected, the wetlands would need to be adjacent and the surface connected to the Main Open Ditch of this district.

Therefore, if an improvement option is selected that increases the capacity of the outlet system, impacts to wetlands will need to be considered both under the Farm Bill and Clean Water Act. To determine if wetlands will be impacted, the NRCS requires that all lands in the watershed must have a wetland determination completed prior to any construction by the District. The landowners or their tenants are the only individuals that can request this determination. If a landowner does not request a certified wetland determination and the District proceeds with an improvement project, the landowner may be found to be in violation of the farm program rules and not eligible for program benefits. In addition, the USDA could file claim for refund of farm program payments. Therefore, if any of the proposed improvement options is approved, we will encourage all landowners within the watershed boundary to request a certified wetland determination from the NRCS. Please note the NRCS will only provide determinations on agricultural lands producing a commodity crop. For other lands, a consultant will need to be hired to make the wetland determination. Additionally, if a landowner refuses to sign up for a determination, we will

recommend the Board approve hiring a consultant to make the wetland determination assessment for review by the NRCS. The cost of these determinations will be paid by the District.

To evaluate if there would be farmed wetland impacted by this improvement, we used the US Fish & Wildlife Service wetland inventory maps and found there to be potentially 4.4 acres of farmed wetlands affected by the proposed open ditch improvement. The cost for mitigation of these 4.4 acres is estimated in our report at \$88,000. If verified to be impacted wetland, we would recommend the cost of mitigation be shared between the landowner and the District. This is because all landowners in the District will benefit from the improvement in capacity, and therefore it has become typical that the District participates along with the landowner in the cost of mitigation.

6.3 Recommendations

After evaluation of relief options, the open ditch provides the most cost effective solution for the requested drainage relief. Therefore, in our report we recommend a new main open ditch with lateral be constructed. In addition, we find the proposed water quality enhancements will effectively reduce sediment delivery to Browns Lake and therefore at a minimum maintain the current water quality in the lake. These enhancements are not required by law, but we recommend the landowners of the District consider them as part of the open ditch project. The total cost of the open ditch/lateral project including the water quality measure is still more cost effective than the tile improvement options.

Therefore, we recommend the Board of Supervisors, acting as Trustees for the District hold a public hearing on this report to consider the input of the District's landowners.

Annexation & Reclassification. As Section 4.1 explains, annexation of the lands receiving benefit that are currently not assessed by the District is recommended. Also, reclassification of the Orton Slough Drainage District is considered necessary as discussed in Section 4.2.

Installment Payments. Iowa Drainage District Law Code Section 468.57 provides that large assessments may be paid in not less than ten (10) or more than twenty (20) annual installments at the discretion of the Board of Supervisors acting as Trustees for the District. Based on the estimated cost of this project, we recommend ten (10) installments be considered by the Board.

It is recommended that the Board of Supervisors of Woodbury County, acting as trustees for the Orton Slough Drainage District, take appropriate action, with legal guidance, to accomplish the following:

- 1) Tentatively accept this Engineer's Report as filed.
- 2) Hold a public hearing and consider the input of the District landowners.
- 3) Adopt the proposed improvement option and modify as deemed appropriate, to satisfy the desires of the District.
- 4) Direct the engineer to prepare the necessary plans and specifications, obtain the necessary permits, and to proceed toward a bid letting.
- 5) Initiate wetland mitigation proceedings.
- 6) Pursue acquisition of additional right-of-way by the appointment of right-of-way appraisers.
- 7) Adopt a resolution of necessity for the annexation of additional lands, if that is the desire of the District.
- 8) Initiate reclassification procedures.

APPENDIX A

ENGINEER'S ESTIMATES OF PROBABLE COSTS

- OPTION 1: RELIEF TILE OPTION
- OPTION 2: REPLACEMENT TILE
- OPTION 3: MAIN OPEN DITCH CONSTRUCTION
- OPTION 3A: MAIN OPEN DITCH & LATERAL NO. 1 CONSTRUCTION

ENGINEER'S ESTIMATE OF PROBABLE COSTS
ORTON SLOUGH DRAINAGE DISTRICT, WOODBURY COUNTY
OPTION 1: PROPOSED RELIEF TILE PARALLEL TO EXISTING TILE

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.	Mobilization	1	JOB	34,250.00	\$34,250.00
2.	2000D Reinforced Concrete Pipe, 54" Dia.	6,785	LF	95.50	\$647,967.50
3.	Furnish & Install CMP Tile Extension, 60" Dia.	20	LF	92.00	\$1,840.00
4.	54" Dia. R.C.P. Elbow Section, Fabrication Only	3	EA	600.00	\$1,800.00
5.	Drop Inlet Structure, 72" Dia.	1	EA	5,200.00	\$5,200.00
6.	Existing Tile Cross Connection	1	EA	1,000.00	\$1,000.00
7.	Topsoil Strip, Stockpile, Respread	37,695	SY	0.50	\$18,847.50
8.	Tile Trench Stabilization and Cradling Rock	300	TN	25.00	\$7,500.00
9.	Fence Cuts	4.00	EA	235.00	\$940.00

Estimated Construction Subtotal: **\$719,345.00**

Engineering Services:

Design Survey	\$6,550.00
Research, Preliminary Design & Informal Hearings	\$30,000.00
Design Plans, Engineer's Report & Formal Hearings	\$19,000.00
Final Plans, Specifications & Bidding	\$14,750.00
Construction Administration	\$12,300.00
Construction Staking & Observation	\$15,600.00
Wetland Determination, Permits & Mitigation	\$3,500.00
Legal & Auditor Services, Publications, Misc.	\$1,200.00
Crop Damages (7.8 AC Corn @ \$745.00/AC)	\$5,850.00
Contingencies	\$71,900.00

Improvement Project Cost Subtotal : **\$899,995.00**

Other Potential District Costs:

Annexation	\$2,000.00
Reclassification	\$18,060.00
Project Warrant Interest	\$84,200.00
Wetland Mitigation - 50% District for 4.4 AC	\$44,000.00

TOTAL ESTIMATED PROJECT COST, OPTION 1 **\$1,048,255.00**

Average Cost per Assessed Acre (2394 acres)	\$437.87
Average Cost per Watershed Acre (2761 acres)	\$379.66
Average Cost per Watershed Acre for 10 years	\$37.97

Other Non-District Costs:

1.	Concrete Pipe, 3750D, Trenchless, 54" Dia. @ STA 49+50 - I-29	170	LF	650.00	\$110,500.00
2.	Concrete Pipe, 3750D, Trenchless, 54" Dia., STA 24+50 - D-51	70	LF	650.00	\$45,500.00

3.	Wetland Mitigation - 50% Landowner for 4.4 AC				\$44,000.00
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Probable Non-District Cost: **\$200,000.00**

**ENGINEERS ESTIMATE OF PROBABLE COSTS
ORTON SLOUGH DRAINAGE DISTRICT, WOODBURY COUNTY
OPTION 2: PROPOSED NEW TILE ALIGNMENT**

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.	Mobilization	1	JB	39,300.00	\$39,300.00
2.	2000D Reinforced Concrete Pipe, 60" Dia.	6,785	LF	108.00	\$732,780.00
3.	Furnish & Install CMP Tile Extension, 72" Dia.	20	LF	116.00	\$2,320.00
4.	60" Dia. R.C.P. Elbow Section, Fabrication Only	2	EA	800.00	\$1,600.00
5.	Drop Inlet Structure, 84" Dia.	1	EA	7,500.00	\$7,500.00
6.	Junction Structure, 8'x8' Box	1	EA	9,500.00	\$9,500.00
7.	60" Dia. R.C.P. 45° Elbow Section	4	EA	1,000.00	\$4,000.00
8.	Topsoil Strip, Stockpile, Respread	37,695.00	SY	0.50	\$18,847.50
9.	Tile Trench Stabilization and Cradling Rock	350.00	TN	25.00	\$8,750.00
10.	Fence Cuts	4.00	EA	235.00	\$940.00

Estimated Construction Subtotal: \$825,537.50

Engineering Services:

Design Survey	\$7,200.00
Research, Preliminary Design & Informal Hearings	\$30,000.00
Design Plans, Engineer's Report & Formal Hearings	\$19,000.00
Final Plans, Specifications & Bidding	\$16,000.00
Construction Administration	\$13,400.00
Construction Staking & Observation	\$17,000.00
Wetland Determination, Permits & Mitigation	\$3,500.00
Legal & Auditor Services, Publications, Misc.	\$1,200.00
Crop Damages	
7.8 AC, Corn @ \$745.00/AC	\$5,850.00
Contingencies	\$78,600.00

Improvement Project Cost Subtotal \$1,017,287.50

Other Potential District Costs:

Annexation	\$2,000.00
Reclassification	\$18,060.00
Project Warrant Interest	\$91,500.00
Wetland Mitigation - 50% District for 4.4 AC	\$44,000.00

TOTAL ESTIMATED PROJECT COST, OPTION 2: \$1,172,847.50

Average Cost per Assessed Acre (2394 acres)	\$489.91
Average Cost per Watershed Acre (2761 acres)	\$424.79
Average Cost per Watershed Acre for 10 years	\$42.48

Other Non-District Costs:

1.	Concrete Pipe, 3750D, Trenchless, 60" Dia. @ STA 49+50 - I-29	170	LF	830.00	\$141,100.00
2.	Concrete Pipe, 3750D, Trenchless, 60" Dia., STA 24+50 - D-51	70	LF	830.00	\$58,100.00
3.	Wetland Mitigation - 50% Landowner for 4.4 AC				\$44,000.00

Probable Non-District Cost : \$243,200.00

**ENGINEER'S ESTIMATE OF PROBABLE COSTS
ORTON SLOUGH DRAINAGE DISTRICT, WOODBURY COUNTY
OPTION 3: PROPOSED OPEN DITCH**

MAIN OPEN DITCH

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.	Mobilization	1	JOB	17,300.00	\$17,300.00
2.	Topsoil Strip, Stockpile, Respread	122,617.00	SY	0.50	\$61,308.50
3.	Open Ditch Excavation	59,319	CY	2.95	\$174,991.05
4.	Spoil Bank Leveling (Two Sides)	68.60	STA	125.00	\$8,575.00
5.	Furnish & Install CMP Metal Surface Drain Pipe				
a.	15" Dia.	120	LF	24.00	\$2,880.00
b.	18" Dia.	200	LF	28.00	\$5,600.00
c.	24" Dia.	120	LF	33.00	\$3,960.00
6.	Furnish & Install 60" CMP, Outlet Pipe	60	LF	96.00	\$5,760.00
7.	Fence Removal & Disposal	4.00	STA	55.00	\$220.00
8.	Open Ditch Fertilizing & Seeding	68.60	STA	55.00	\$3,773.00
9.	Roadside Spoil Seeding & Fertilizing	66.20	STA	55.00	\$3,641.00
10.	Furnish & Install Silt Screen Fence	1	JOB	2,500.00	\$2,500.00
Estimated Main Open Ditch Subtotal :					\$290,508.55

WATER QUALITY MEASURES

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
11.	Furnish & Install Detention Chambers				\$25,000.00
12.	Remove Existing Tile				\$1,200.00
13.	Furnish & Install Tile Cap to Existing Tile				\$500.00
14.	Furnish & Install 60" Dia. Drop Riser				\$5,500.00
15.	Furnish & Install 36" Dia. Tile to Open Ditch				\$32,130.00
16.	Furnish & Install 42" Dia. CMP Tile Outlet				\$1,100.00
17.	Furnish & Install Rock Riffles				\$2,500.00
18.	Channel Sediment Trap Excavation				\$4,194.90
Estimated Water Quality Measures Subtotal :					\$72,124.90

Estimated Construction Subtotal: \$362,633.45

Engineering Services:

Design Survey	\$3,300.00
Research, Preliminary Design & Informal Hearings	\$30,000.00
Design Plans, Engineer's Report & Formal Hearings	\$19,000.00
Final Plans, Specifications & Bidding	\$7,400.00
Construction Administration	\$6,200.00
Construction Staking & Observation	\$7,800.00
Wetland Determination, Permits & Mitigation	\$3,500.00
Legal & Auditor Services, Publications, Misc.	\$1,200.00
Crop Damages	
Main Open Ditch (25.3 AC of Work Limit, Corn @ \$745.00/AC)	\$18,848.50
Contingencies	\$35,900.00

Improvement Project Cost Subtotal \$495,781.95

**ENGINEER'S ESTIMATE OF PROBABLE COSTS
ORTON SLOUGH DRAINAGE DISTRICT, WOODBURY COUNTY
OPTION 3: PROPOSED OPEN DITCH
MAIN OPEN DITCH**

Other Potential District Costs:

Right-of-Way

MAIN OPEN DITCH

Taken R.O.W. (11.31 AC @ \$8,500.00/AC)	\$96,135.00
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Easement R.O.W. (4.15 AC @ \$660.00/AC)	\$2,739.00
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Engineering	\$4,200.00
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Annexation	\$2,000.00
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Reclassification	\$18,060.00
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Geotechnical Investigation	\$7,500.00
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Project Warrant Interest	\$46,500.00
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Wetland Mitigation - 50% District for 4.4 AC	\$44,000.00
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TOTAL ESTIMATED PROJECT COST, OPTION 3	\$716,915.95
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Average Cost per Assessed Acre (2394 acres)	\$299.46
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Average Cost per Watershed Acre (2761 acres)	\$259.66
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Average Cost per Watershed Acre for 10 years	\$25.97
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Other Non-District Costs:

- | | | | | | |
|----|--|-----|----|--------|--------------|
| 1. | Culvert, Concrete Pipe, 3750D, Trenchless, 60" Dia.,
STA 49+50 - I-29 - Iowa Department of Transportation | 170 | LF | 830.00 | \$141,100.00 |
| 2. | Culvert, Concrete Pipe, 3750D, Trenchless, 60" Dia.,
STA 24+50 - D-51 - Secondary Roads | 70 | LF | 830.00 | \$58,100.00 |
| 3. | Wetland Mitigation - 50% Landowner for 4.4 AC | | | | \$44,000.00 |

ENGINEER'S ESTIMATE OF PROBABLE COSTS
ORTON SLOUGH DRAINAGE DISTRICT, WOODBURY COUNTY
OPTION 3A: PROPOSED MAIN OPEN DITCH & LATERAL NO. 1

MAIN OPEN DITCH

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.	Mobilization	1	JOB	21,000.00	\$21,000.00
2.	Topsoil Strip, Stockpile, Respread	122,617	SY	0.50	\$61,308.50
3.	Open Ditch Excavation	59,319	CY	2.95	\$174,991.05
4.	Spoil Bank Leveling (Two Sides)	68.60	STA	125.00	\$8,575.00
5.	Furnish & Install CMP Metal Surface Drain Pipe				
a.	15" Dia.	120	LF	24.00	\$2,880.00
b.	18" Dia.	200	LF	28.00	\$5,600.00
c.	24" Dia.	120	LF	33.00	\$3,960.00
6.	Furnish & Install 60" CMP, Outlet Pipe	60	LF	96.00	\$5,760.00
7.	Fence Removal & Disposal	4.00	STA	55.00	\$220.00
8.	Open Ditch Fertilizing & Seeding	68.60	STA	55.00	\$3,773.00
9.	Roadside Spoil Seeding & Fertilizing	66.20	STA	55.00	\$3,641.00
10.	Furnish & Install Silt Screen Fence	1.00	JOB	2,500.00	\$2,500.00

Estimated Main Open Ditch Subtotal :

\$294,208.55

LATERAL NO. 1

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
11.	Topsoil Strip, Stockpile, Respread	49,900.00	SY	0.50	\$24,950.00
12.	Open Ditch Excavation	12,139	CY	2.95	\$35,810.05
13.	Spoil Bank Leveling (Two Sides)	29.94	STA	125.00	\$3,742.50
14.	Furnish & Install 42" CMP, Driveway Culvert, STA 83+75	60	LF	65.00	\$3,900.00
15.	Open Ditch Fertilizing & Seeding	29.94	STA	55.00	\$1,646.70
16.	Roadside Spoil Seeding & Fertilizing	28.94	STA	55.00	\$1,591.70

Estimated Lateral No. 1 Subtotal :

\$71,640.95

WATER QUALITY MEASURES

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
17.	Furnish & Install Detention Chambers				\$25,000.00
18.	Remove Existing Tile				\$1,200.00
19.	Furnish & Install Tile Cap to Existing Tile				\$500.00
20.	Furnish & Install 60" Dia. Drop Riser				\$5,500.00
21.	Furnish & Install 36" Dia. Tile to Open Ditch				\$32,130.00
22.	Furnish & Install 42" Dia. CMP Tile Outlet				\$1,100.00
23.	Furnish & Install Rock Riffles				\$2,500.00
24.	Channel Sediment Trap Excavation				\$4,194.90

Estimated Water Quality Measures Subtotal :

\$72,124.90

Estimated Construction Subtotal:

\$437,974.40

Engineering Services:

Design Survey	\$4,000.00
Research, Preliminary Design & Informal Hearings	\$30,000.00
Design Plans, Engineer's Report & Formal Hearings	\$19,000.00
Final Plans, Specifications & Bidding	\$9,000.00
Construction Administration	\$7,500.00
Construction Staking & Observation	\$9,500.00
Wetland Determination, Permits & Mitigation	\$3,500.00

**ENGINEER'S ESTIMATE OF PROBABLE COSTS
ORTON SLOUGH DRAINAGE DISTRICT, WOODBURY COUNTY
OPTION 3A: PROPOSED MAIN OPEN DITCH & LATERAL NO. 1**

Legal & Auditor Services, Publications, Misc.	\$1,200.00
Crop Damages	
Main Open Ditch (25.3 AC of Work Limit, Corn @ \$745.00/AC)	\$18,848.50
Lateral No. 1 (10.3 AC of Work Limit, Corn @ \$745.00/AC)	\$7,673.50
Contingencies	\$43,800.00
Improvement Project Cost Subtotal	\$591,996.40

Other Potential District Costs:

Right-of-Way	
MAIN OPEN DITCH	
Taken R.O.W. (11.31 AC @ \$8,500.00/AC)	\$96,135.00
Easement R.O.W. (4.15 AC @ \$660.00/AC)	\$2,739.00
Lateral No. 1	
Taken R.O.W. (4.42 AC @ \$8,500.00/AC)	\$45,900.00
Easement R.O.W. (2.26 AC @ \$660.00/AC)	\$1,518.00
Engineering	\$5,000.00
Annexation	\$2,000.00
Reclassification	\$24,060.00
Geotechnical Investigation	\$7,500.00
Project Warrant Interest	\$55,000.00
Wetland Mitigation - 50% District for 4.4 AC	\$44,000.00
TOTAL ESTIMATED PROJECT COST, OPTION 3A:	\$875,848.40

Average Cost per Assessed Acre (2394 acres)	\$365.85
Average Cost per Watershed Acre (2761 acres)	\$317.22
Average Cost per Watershed Acre for 10 years	\$31.72

Other Non-District Costs:

1.	Culvert, Concrete Pipe, 3750D, Trenchless, 60" Dia., STA 49+50 - I-29 - Iowa Department of Transportation	170	LF	830.00	\$141,100.00
2.	Culvert, Corrugated Metal Roadway Pipe, 42" Dia. STA 88+00 - Barker Ave - Secondary Roads	60	LF	65.00	\$3,900.00
3.	Culvert, Concrete Pipe, 3750D, Trenchless, 60" Dia., STA 24+50 - D-51 - Secondary Roads	70	LF	830.00	\$58,100.00
4.	Wetland Mitigation - 50% Landowner for 4.4 AC				\$44,000.00

PRELIMINARY PLAN SHEETS

A.01	TITLE PAGE
A.02	DISTRICT PLAT
A.03	LANDOWNER PLAT
A.04	OPTIONS MAP
A.05	PROPOSED OPEN DITCH WATER QUALITY MEASURES
A.06	DETAILS
D.01-.05	PLAN & PROFILE
X.01-.07	CROSS SECTIONS

ORTON SLOUGH DRAINAGE DISTRICT
PROPOSED IMPROVEMENTS
WOODBURY COUNTY, IOWA
2014

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Planning

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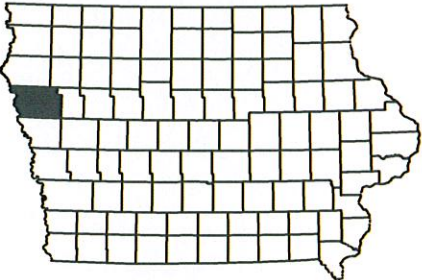
WOODBURY COUNTY, IOWA

I&S PROJECT NO. 13-16118



AERIAL LOCATION MAP
NOT TO SCALE

- INDEX OF SHEETS
- A.01 TITLE PAGE
 - A.02 DISTRICT PLAT
 - A.03 LANDOWNER PLAT
 - A.04 OPTIONS MAP
 - A.05 PROPOSED OPEN DITCH
WATER QUALITY MEASURES
 - A.06 DETAILS
 - D.01-D.05 PLAN & PROFILE
 - X.01-X.07 CROSS SECTIONS



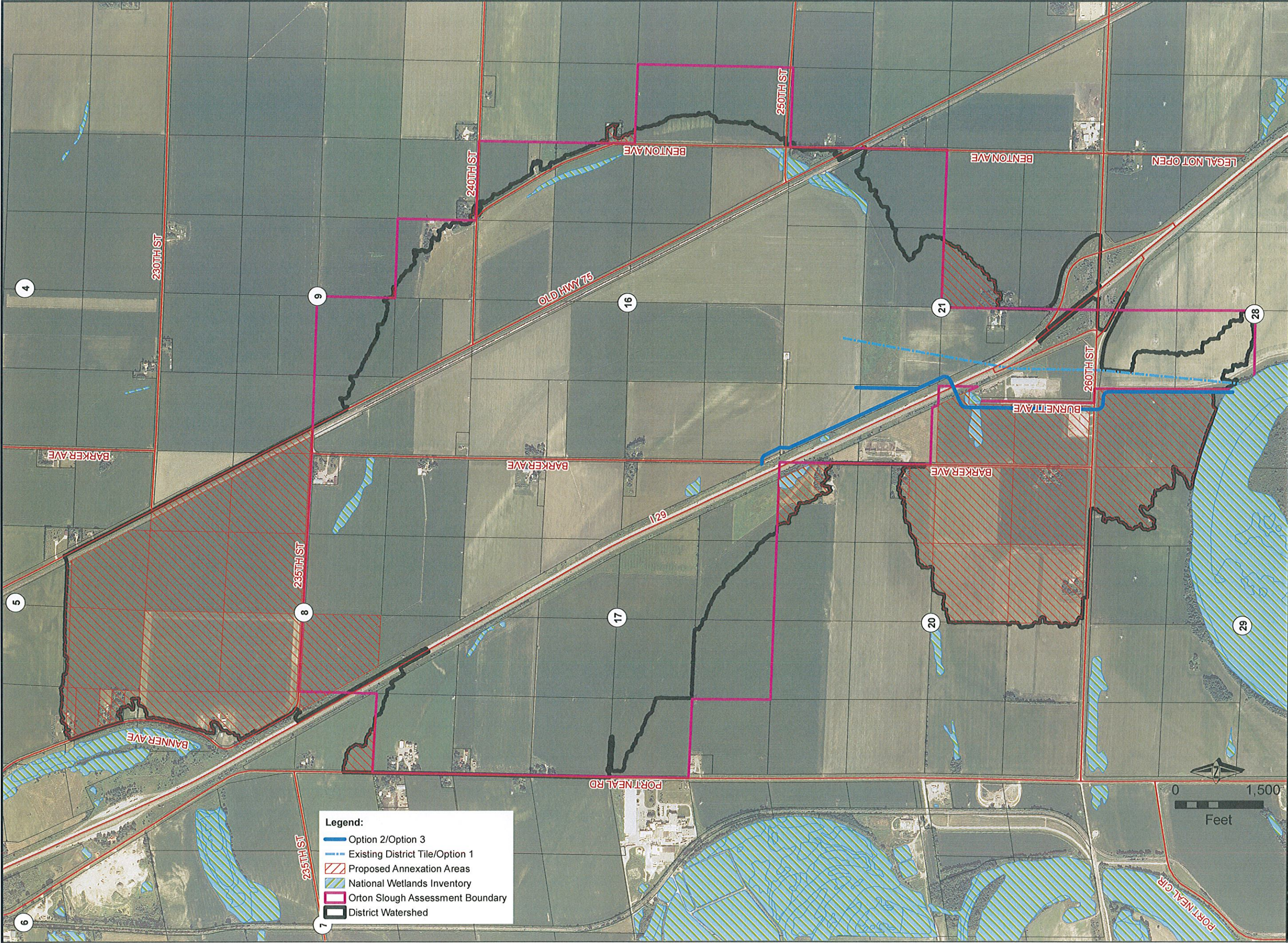
STATE MAP
NOT TO SCALE



COUNTY LOCATION MAP
NOT TO SCALE

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PROJECT		
ORTON SLOUGH DRAINAGE DISTRICT		
WOODBURY COUNTY		IOWA
REVISION SCHEDULE		
NO	DATE	DESCRIPTION
PROJECT NO. 13-16118		
FILE NAME 16188 TITLE SHEET		
DRAWN BY N. KITZROW		
DESIGNED BY B. BLOMME		
REVIEWED BY I. DROESSLER		
ISSUE DATE		
CLIENT PROJECT NO.		
TITLE		
TITLE SHEET		
SHEET		
A.01		



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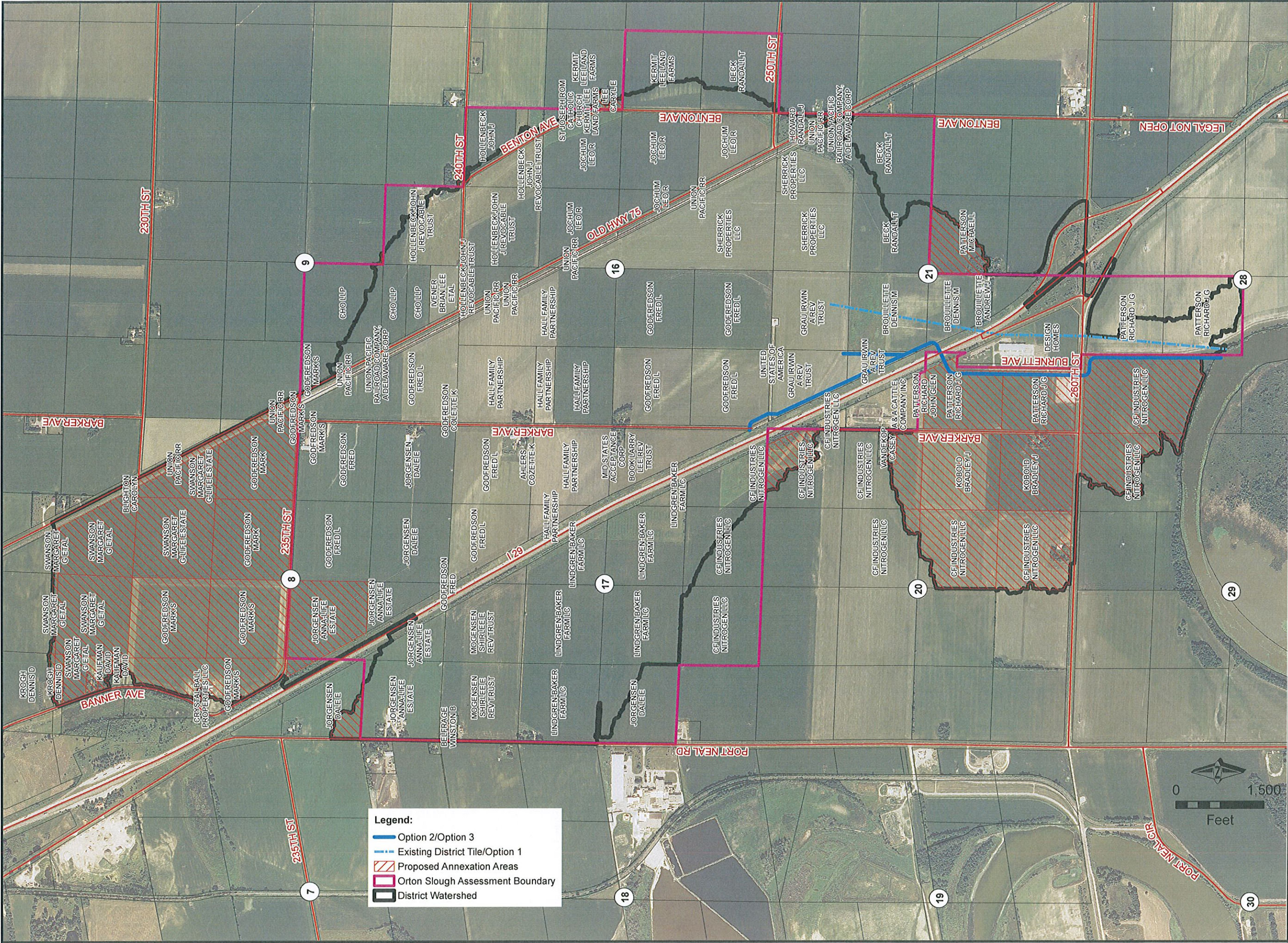
ORTON SLOUGH
DRAINAGE
DISTRICT

WOODBURY COUNTY IOWA

Revision Schedule		
Mark	Date	

PROJECT NO.	13-16118
FILE NAME	A.02-DISTRICT PLAT
DRAWN BY	N. KITZROW
DESIGNED BY	B. BLOMME
REVIEWED BY	I. DROESSLER
ISSUE DATE	
CLIENT PROJECT NO.	

TITLE
**DISTRICT
PLAT**



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ORTON SLOUGH
DRAINAGE
DISTRICT

WOODBURY COUNTY

IOWA

Revision Schedule	
Mark	Date

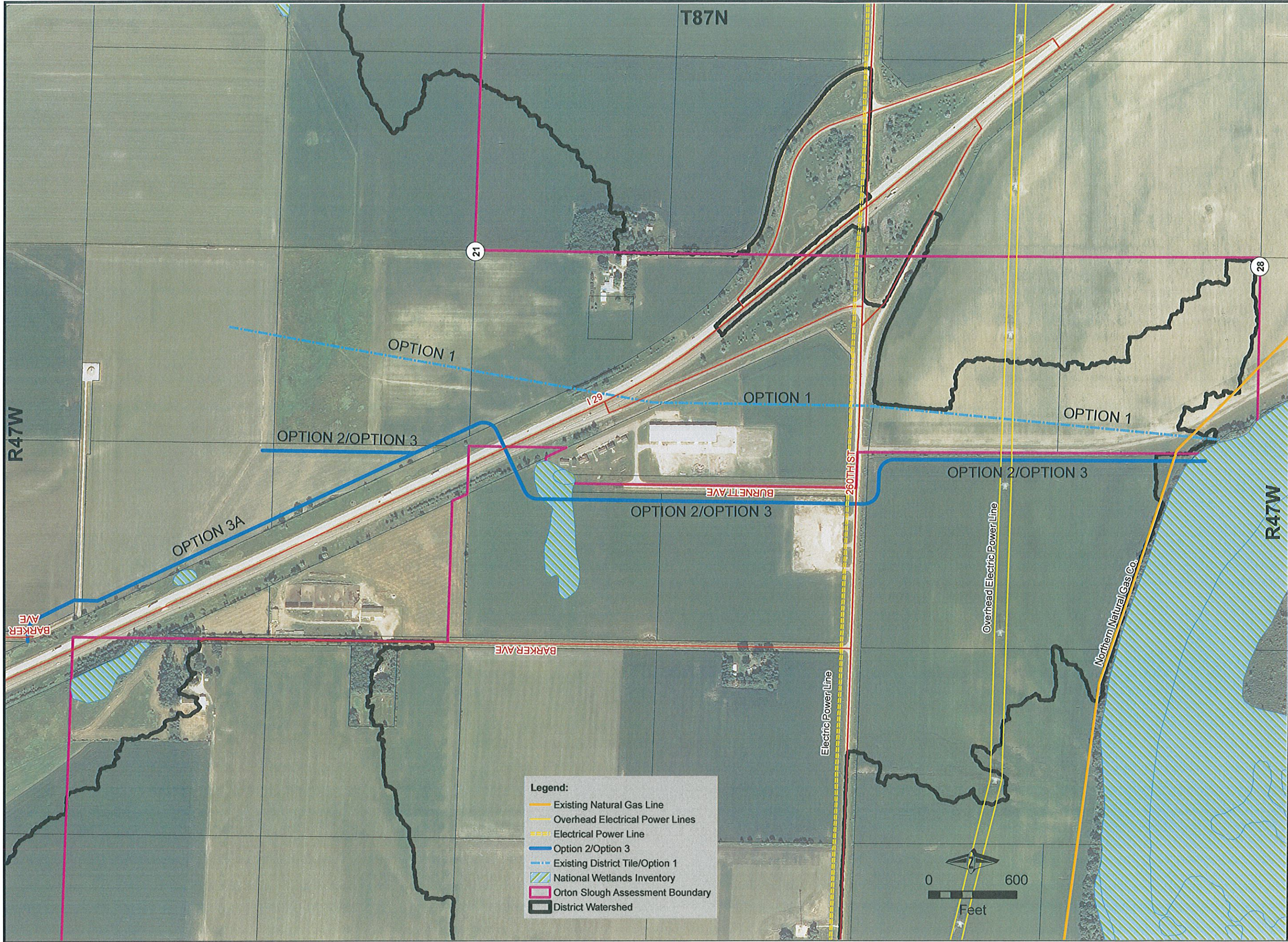
PROJECT NO.	13-16118
FILE NAME	A.03-LANDOWNER PLAT
DRAWN BY	N. KITZROW
DESIGNED BY	B. BLOMME
REVIEWED BY	I. DROESSLER
ISSUE DATE	
CLIENT PROJECT NO.	

TITLE

LANDOWNER
PLAT

SHEET

A.03



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ORTON SLOUGH
DRAINAGE
DISTRICT

WOODBURY COUNTY IOWA

Revision Schedule	
Mark	Date

PROJECT NO. 13-16118

FILE NAME A.03-LANDOWNER PLAT

DRAWN BY N. KITZROW

DESIGNED BY B. BLOMME

REVIEWED BY I. DROESSLER

ISSUE DATE

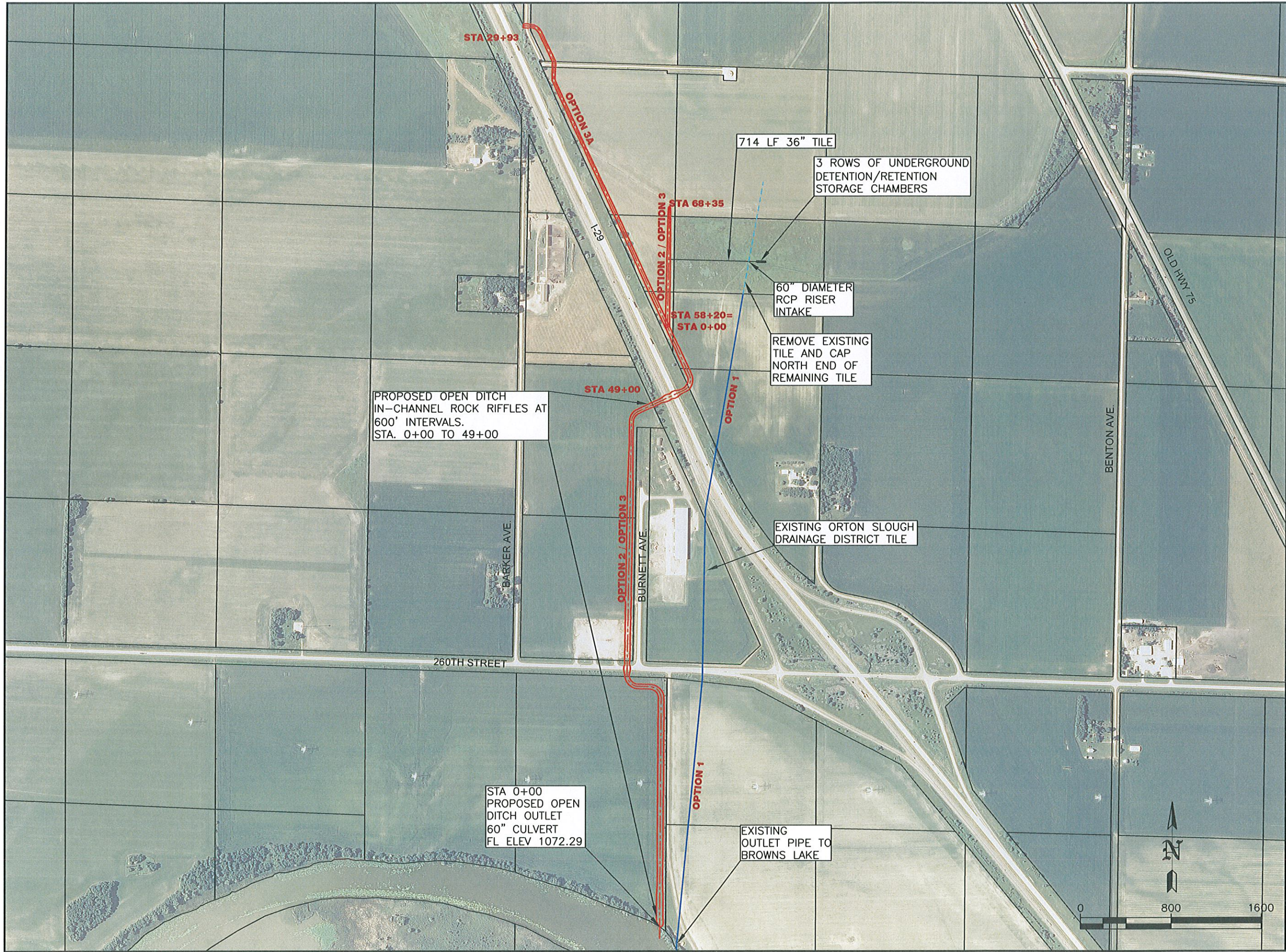
CLIENT PROJECT NO.

TITLE

OPTIONS
MAP

SHEET

A.04



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PROJECT
**ORTON SLOUGH
DRAINAGE
DISTRICT**

WOODBURY COUNTY IOWA

REVISION SCHEDULE		
NO	DATE	DESCRIPTION

PROJECT NO. 13-16118
FILE NAME 16118 WATER QUALITY MEASURES
DRAWN BY N. KITZROW
DESIGNED BY B. BLOMME
REVIEWED BY I. DROESSLER
ISSUE DATE
CLIENT PROJECT NO.

TITLE
**PROPOSED OPEN
DITCH WATER
QUALITY
MEASURES**

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PROJECT

**ORTON SLOUGH
DRAINAGE
DISTRICT**

WOODBURY COUNTY IOWA

REVISION SCHEDULE		
NO	DATE	DESCRIPTION

PROJECT NO. 13-16188
FILE NAME 16118 DETAILS
DRAWN BY N. KITZROW
DESIGNED BY B. BLOMME
REVIEWED BY I. DROESSLER
ISSUE DATE

CLIENT PROJECT NO.

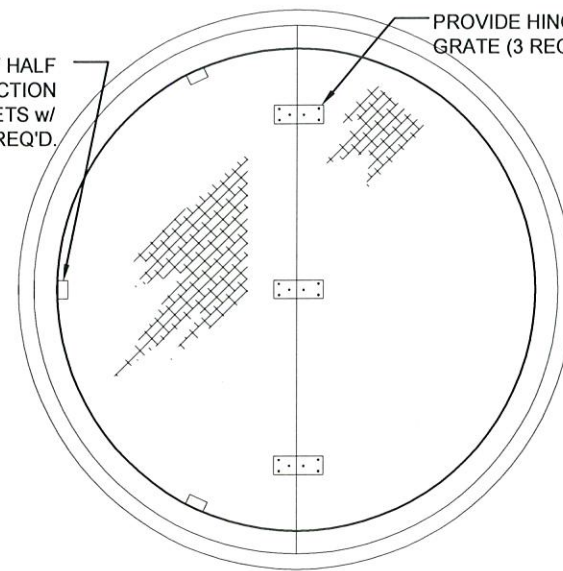
TITLE

DETAILS

SHEET

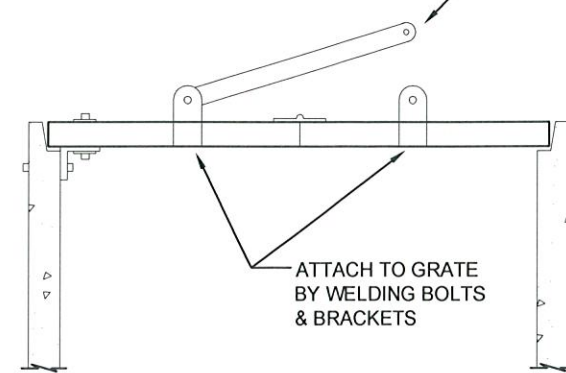
A.06

ATTACH STATIONARY HALF
OF GRATE TO WALL SECTION
WITH ANGLE BRACKETS W/
3/4" BOLTS. 3 REQ'D.



PROVIDE HINGED
GRATE (3 REQ'D)

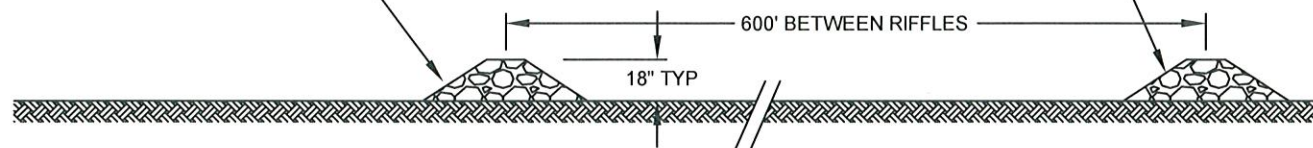
PROVIDE STRAP, BRACKET, LOCK
AND KEYS FOR SECURING GRATING



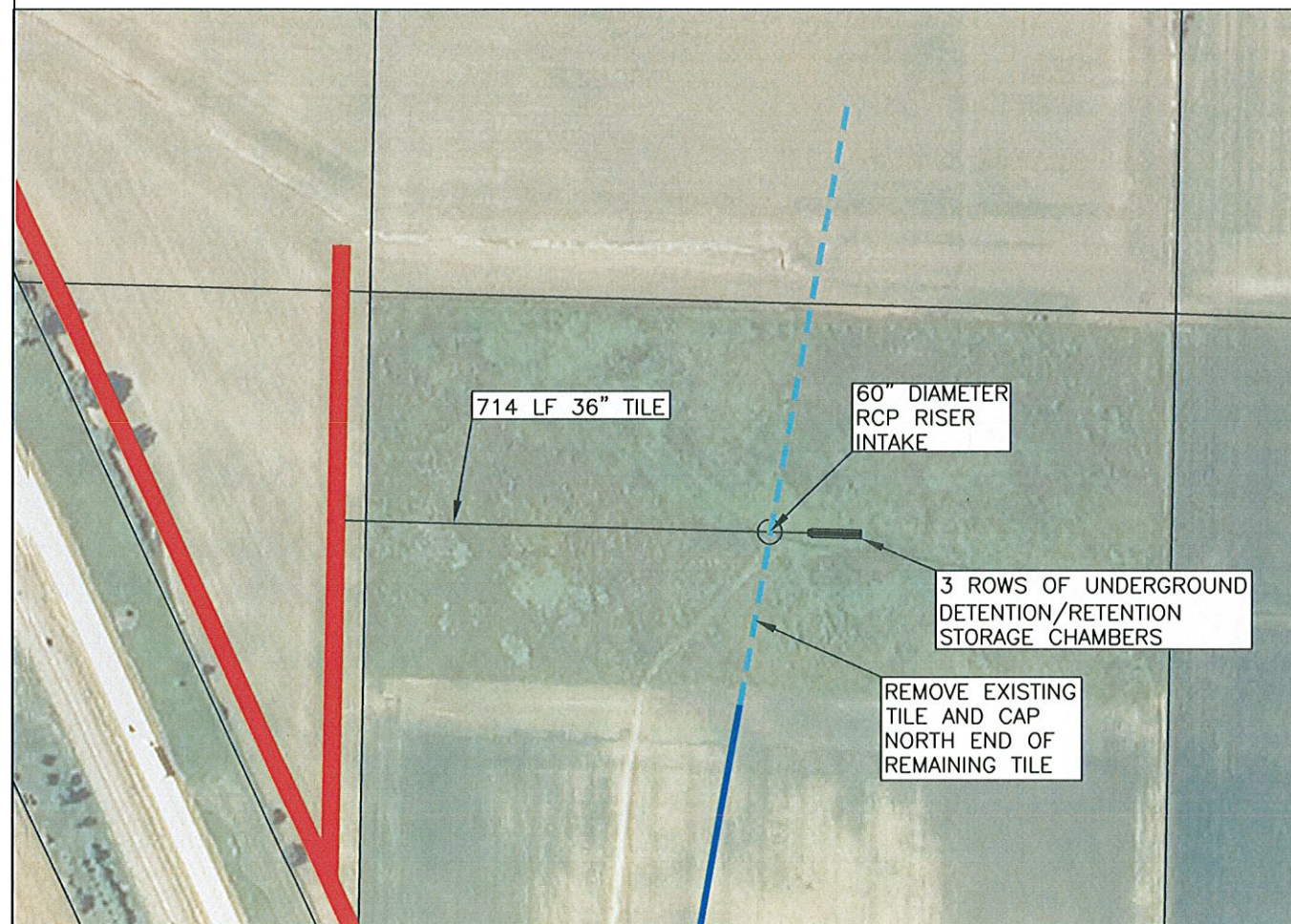
ATTACH TO GRATE
BY WELDING BOLTS
& BRACKETS

CONSTRUCT ROCK RIFFLES
ACROSS FULL WIDTH OF
OPEN DITCH

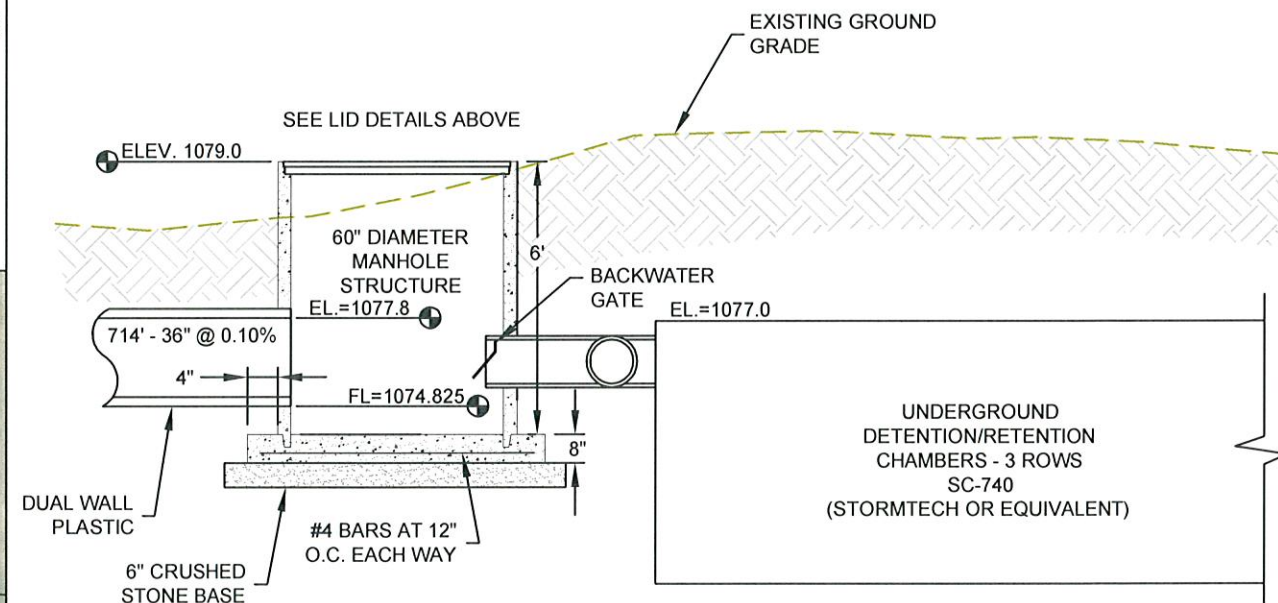
ROCK RIFFLE TO BE
CONSTRUCTED FROM
LIMESTONE LEDGE ROCK
40-120 LBS TYP STONE WEIGHT



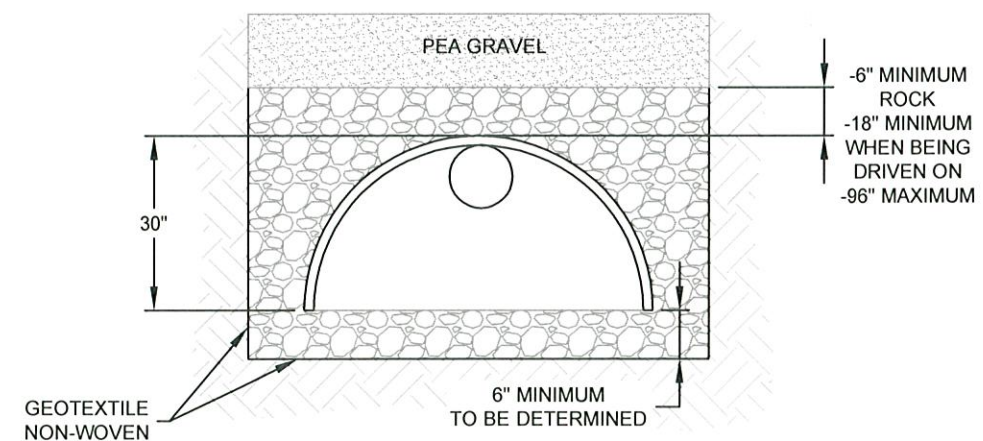
IN-CHANNEL ROCK RIFFLE/POOL
STA. 0+00 TO 48+00



DETENTION/INFILTRATION BASIN



RISER AND CHAMBER



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PROJECT

ORTON SLOUGH
DRAINAGE
DISTRICT

WOODBURY COUNTY IOWA

REVISION SCHEDULE		
NO	DATE	DESCRIPTION

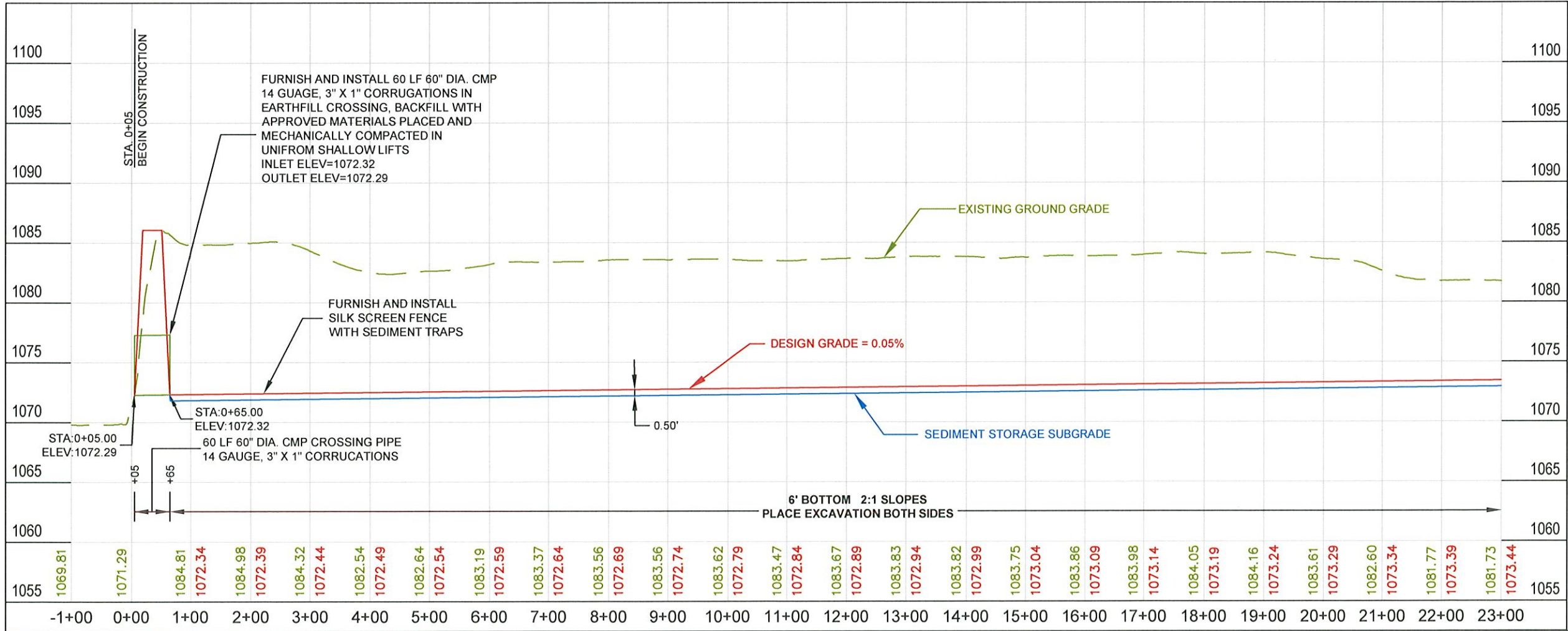
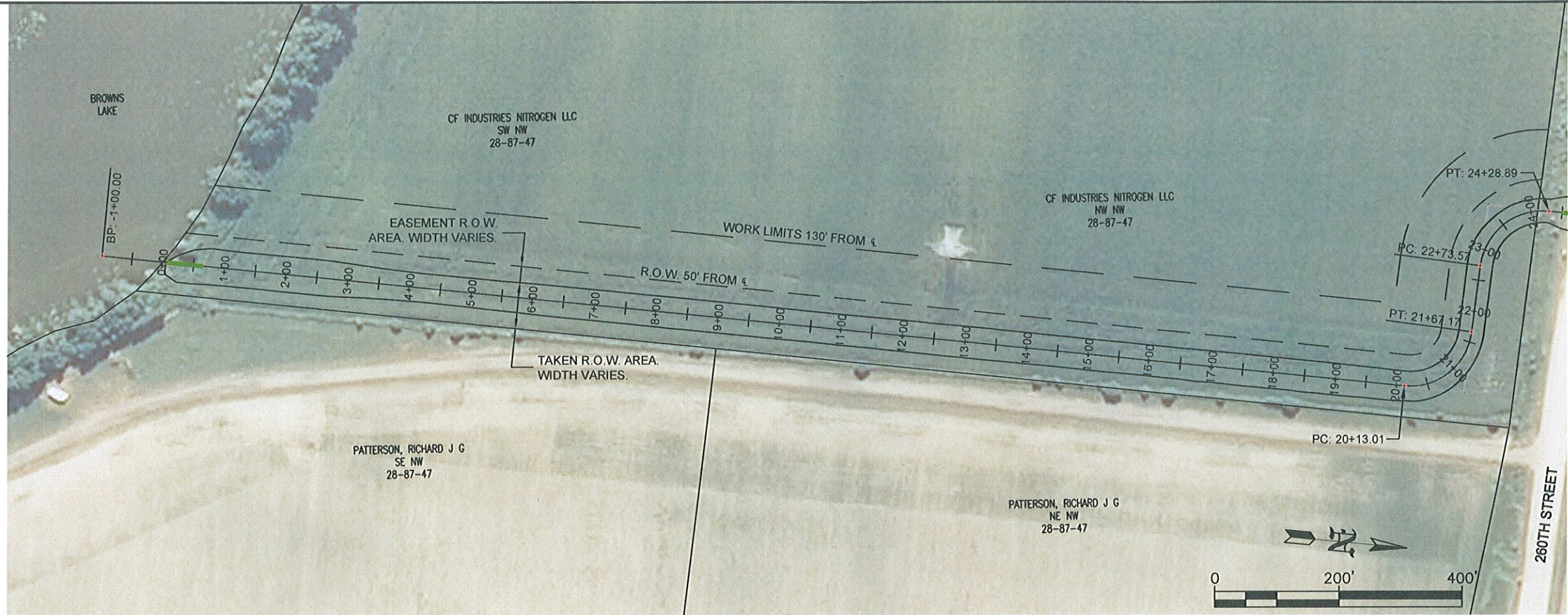
PROJECT NO.	13-16118
FILE NAME	16118 PLAN/PROFILE
DRAWN BY	N. KITZROW
DESIGNED BY	B. BLOMME
REVIEWED BY	I. DROESSLER
ISSUE DATE	
CLIENT PROJECT NO.	

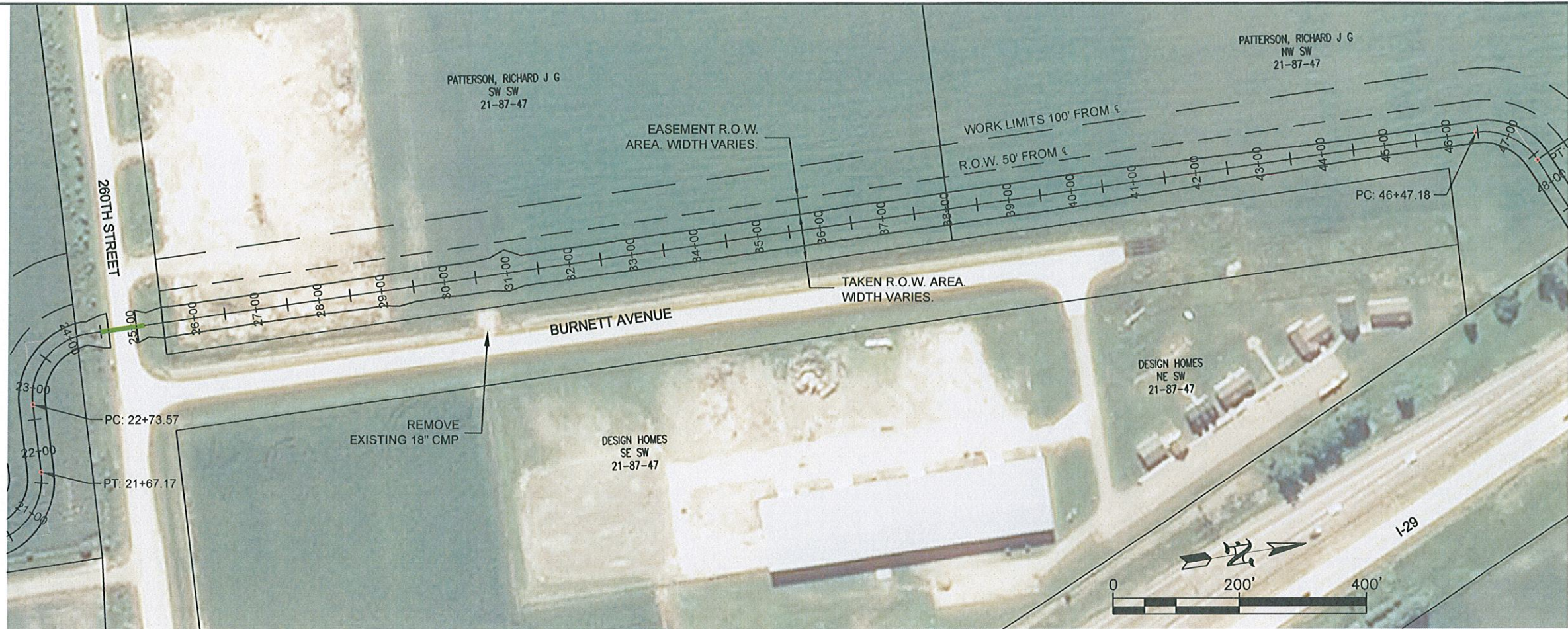
TITLE

PLAN AND
PROFILE
MAIN OPEN DITCH

SHEET

D.01





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PROJECT

**ORTON SLOUGH
DRAINAGE
DISTRICT**

WOODBURY COUNTY IOWA

REVISION SCHEDULE		
NO	DATE	DESCRIPTION

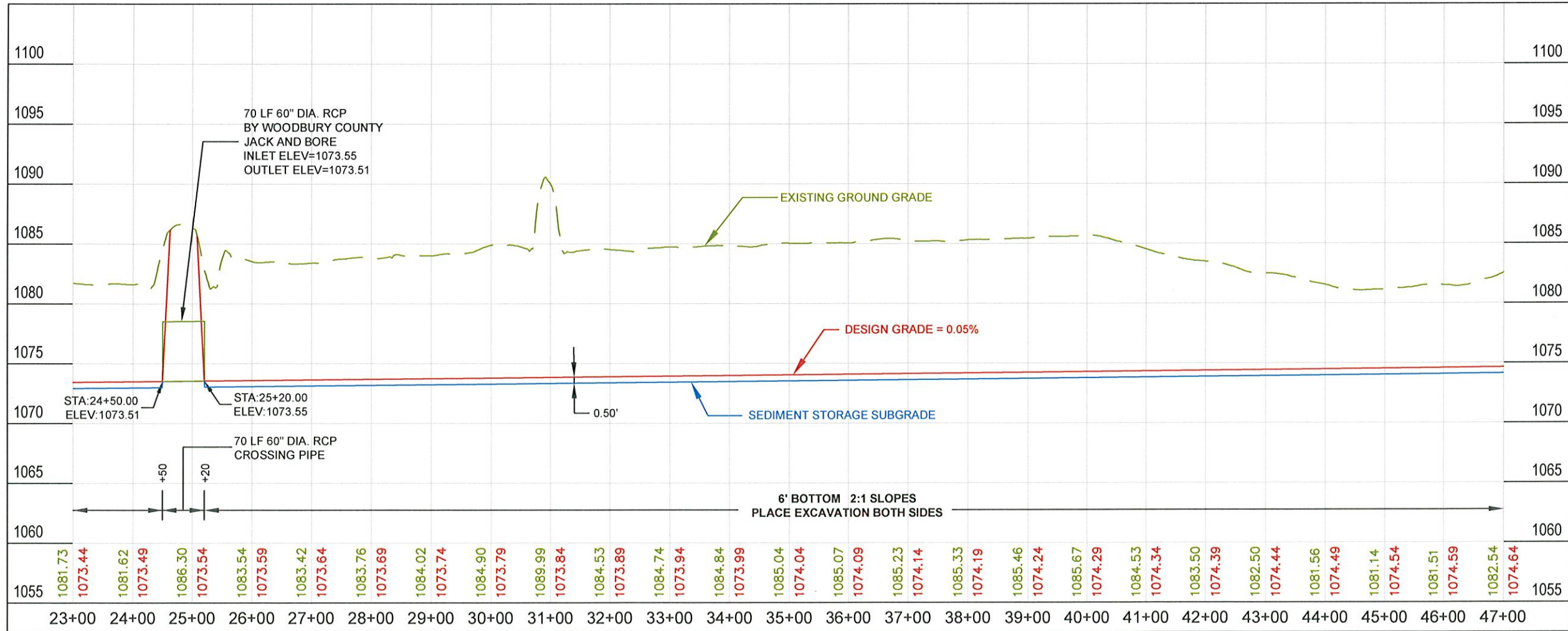
PROJECT NO.	13-16118
FILE NAME	16118 PLAN/PROFILE
DRAWN BY	N. KITZROW
DESIGNED BY	B. BLOMME
REVIEWED BY	I. DROESSLER
ISSUE DATE	
CLIENT PROJECT NO.	

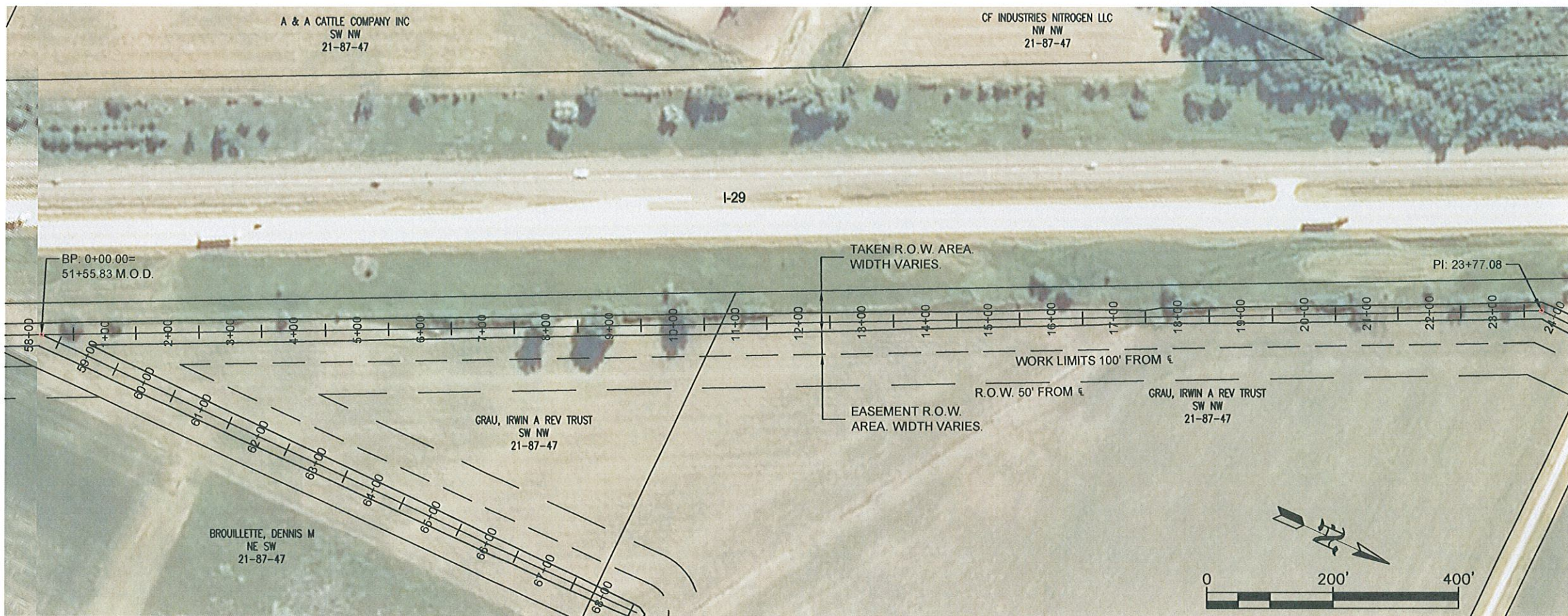
TITLE

**PLAN AND
PROFILE
MAIN OPEN DITCH**

SHEET

D.02





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PROJECT

ORTON SLOUGH
DRAINAGE
DISTRICT

WOODBURY COUNTY IOWA

REVISION SCHEDULE		
NO	DATE	DESCRIPTION

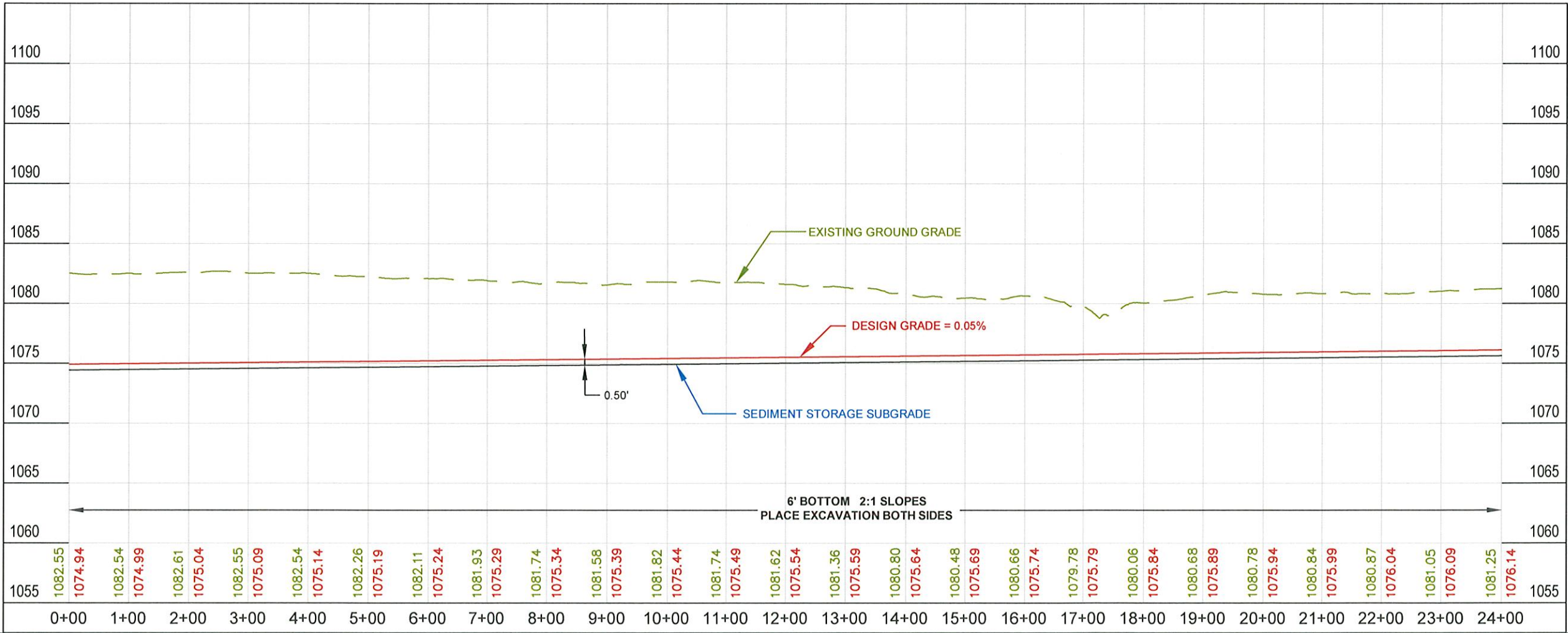
PROJECT NO.	13-16118
FILE NAME	16118 PLANPROFILE
DRAWN BY	N. KITZROW
DESIGNED BY	B. BLOMME
REVIEWED BY	I. DROESSLER
ISSUE DATE	
CLIENT PROJECT NO.	

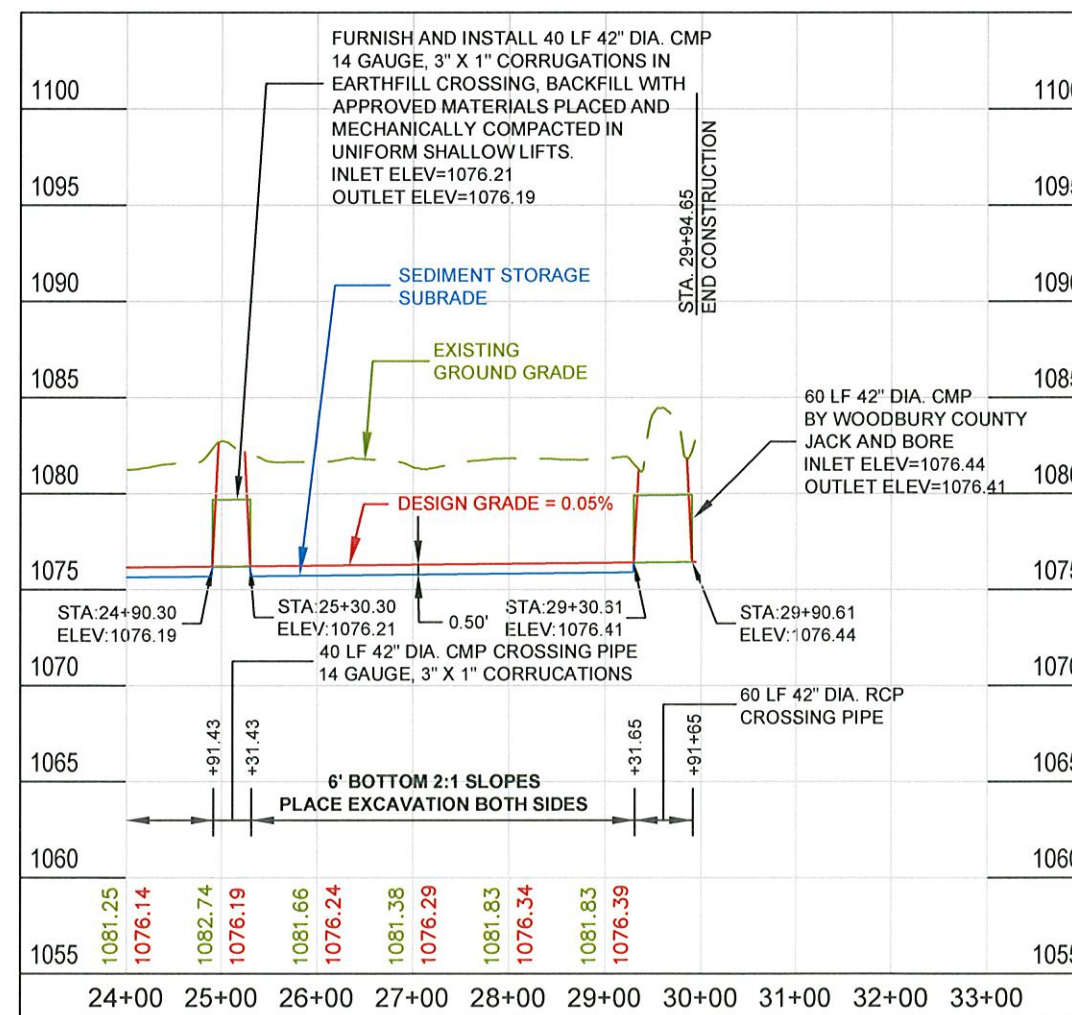
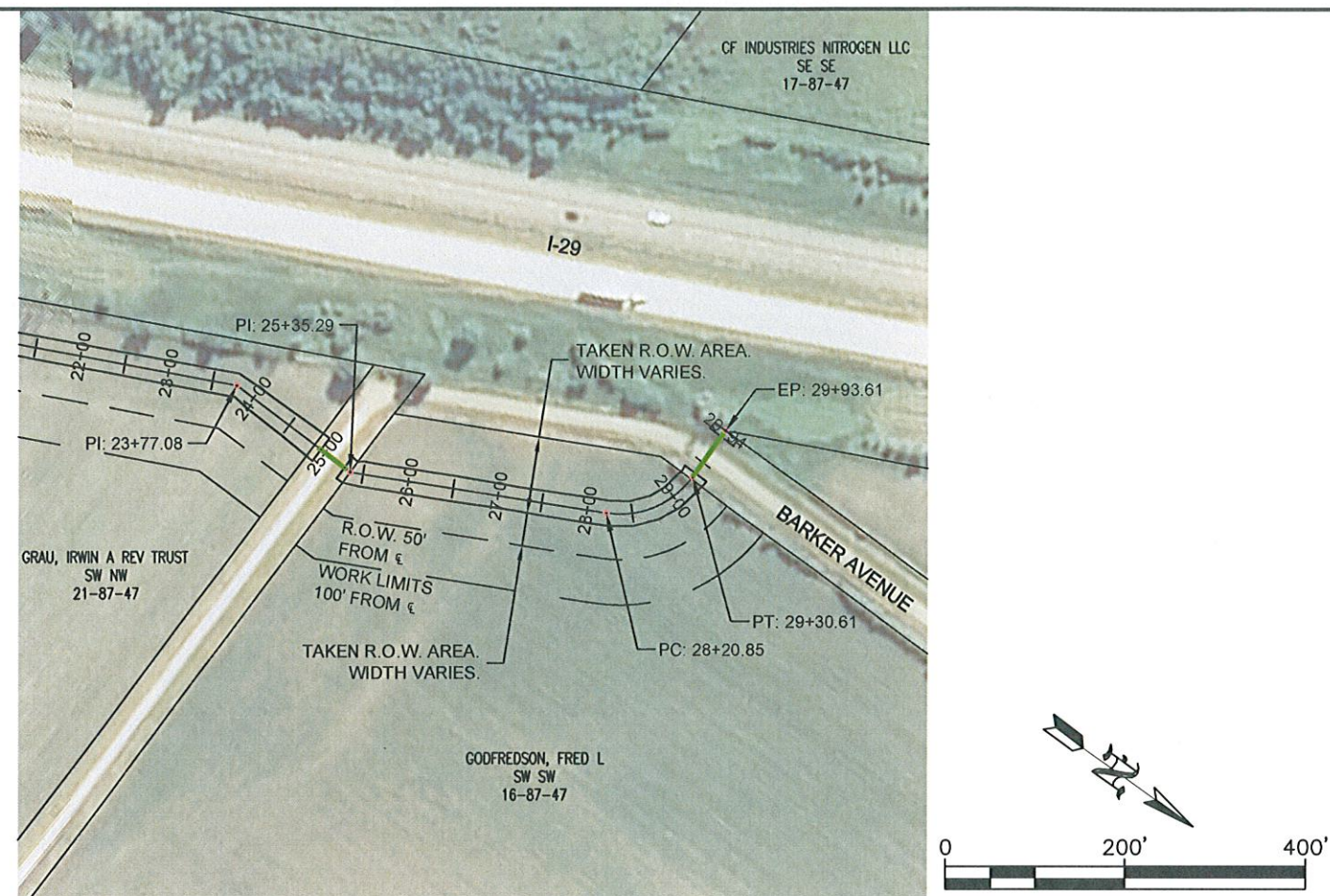
TITLE

PLAN AND
PROFILE
LATERAL 1

SHEET

D.04





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Environmental
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PROJECT

ORTON SLOUGH DRAINAGE DISTRICT

WOODBURY COUNTY IOWA

REVISION SCHEDULE	
NO	DATE DESCRIPTION

PROJECT NO. 13-16118

FILE NAME 16118 PLAN/PROFILE

DRAWN BY N. KITZROW

DESIGNED BY B. BLOMME

REVIEWED BY I. DROESSLER

ISSUE DATE

CLIENT PROJECT NO.

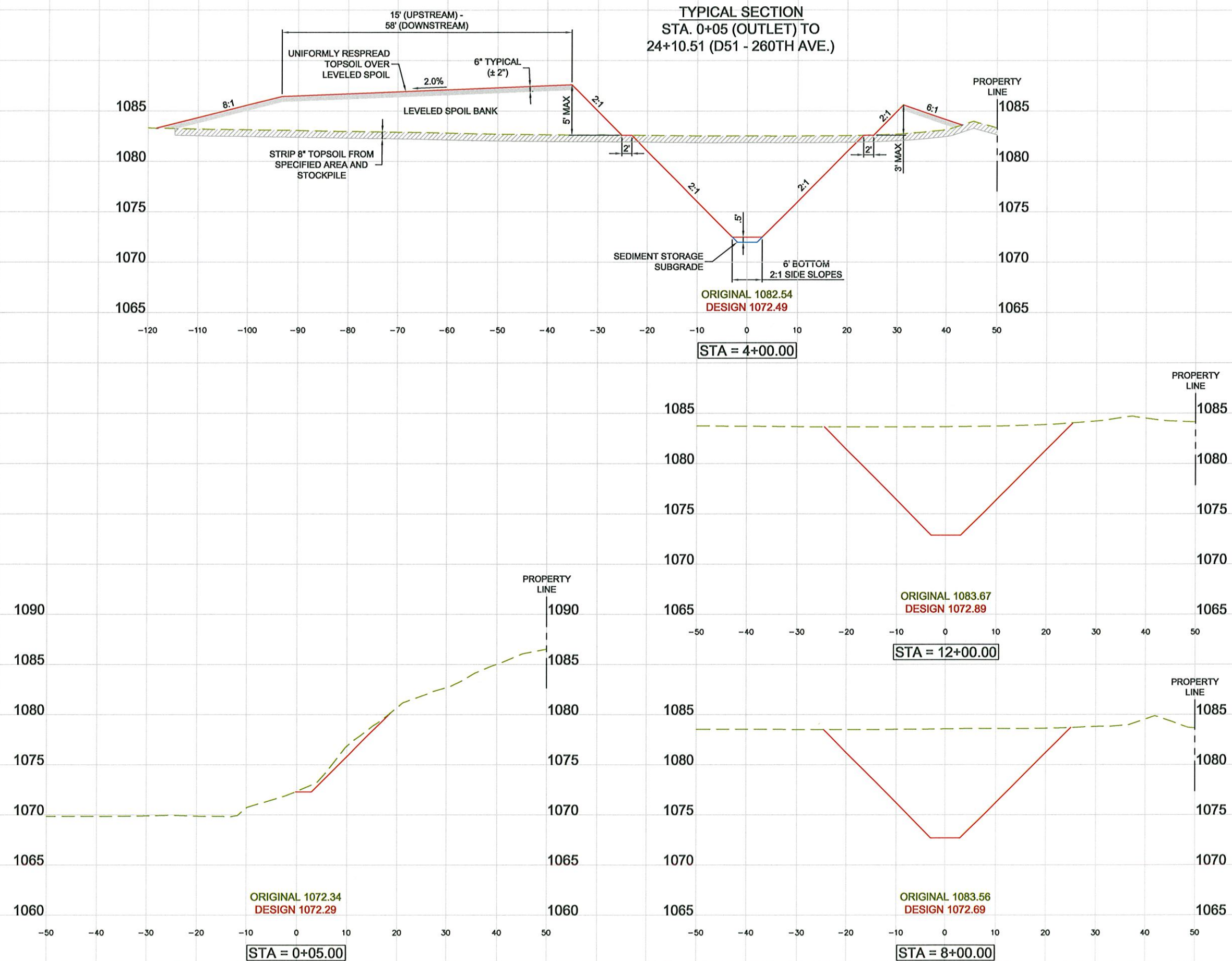
TITLE

PLAN AND PROFILE LATERAL 1

SHEET

D.05

X.01



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PROJECT

ORTON SLOUGH
DRAINAGE
DISTRICT

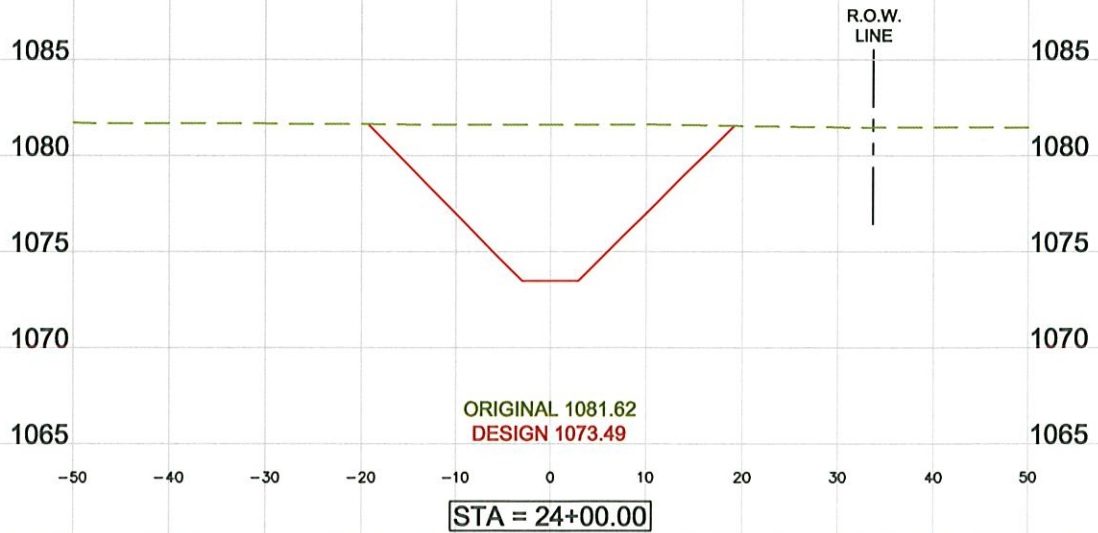
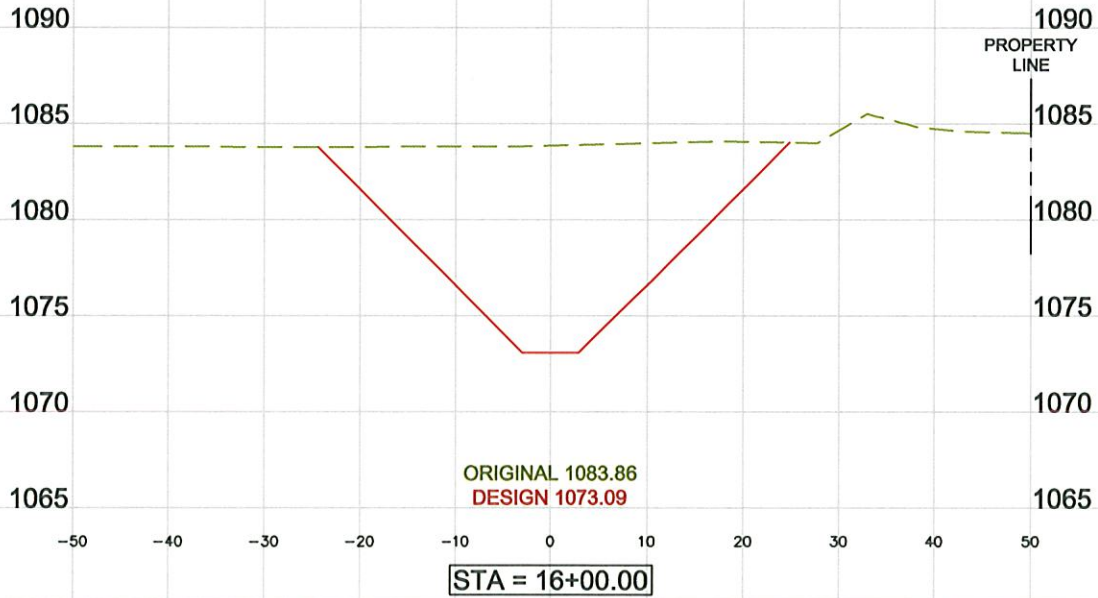
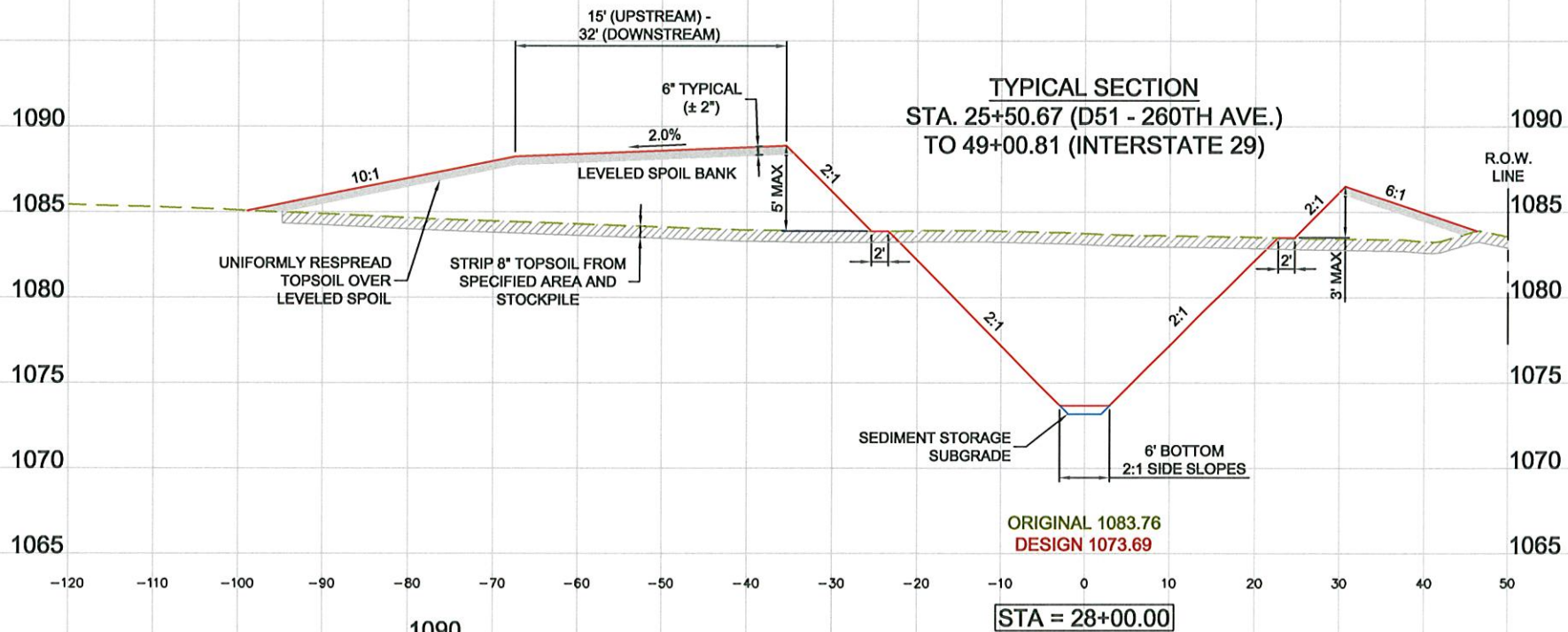
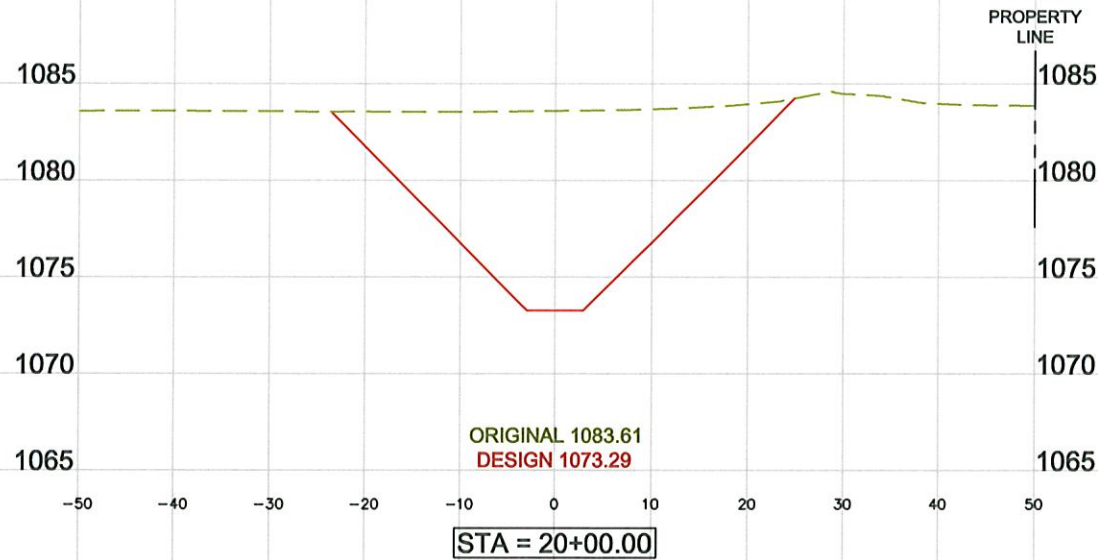
WOODBURY COUNTY IOWA

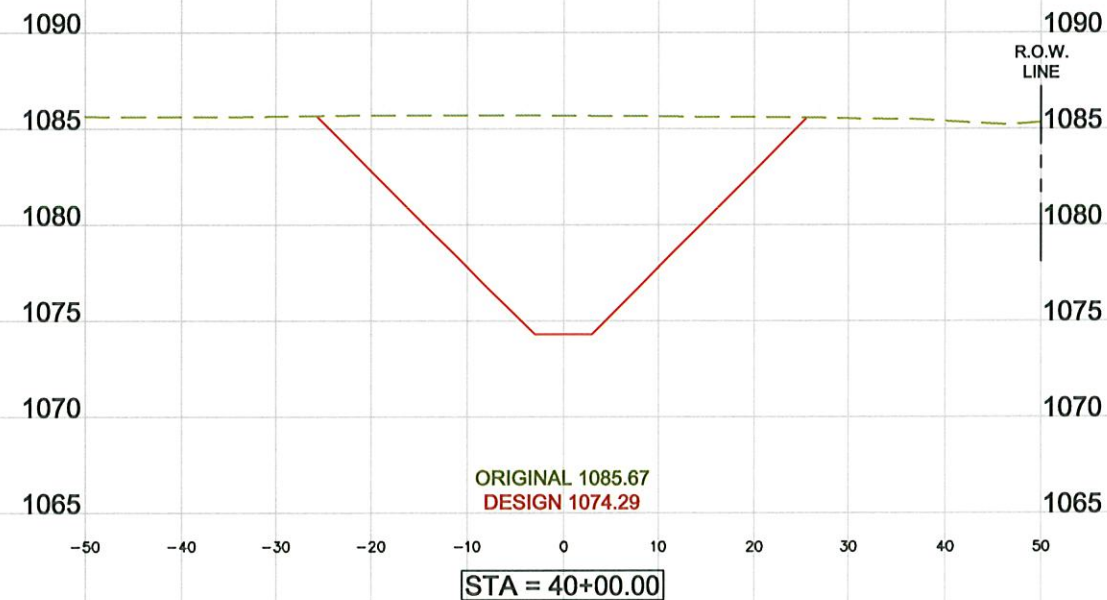
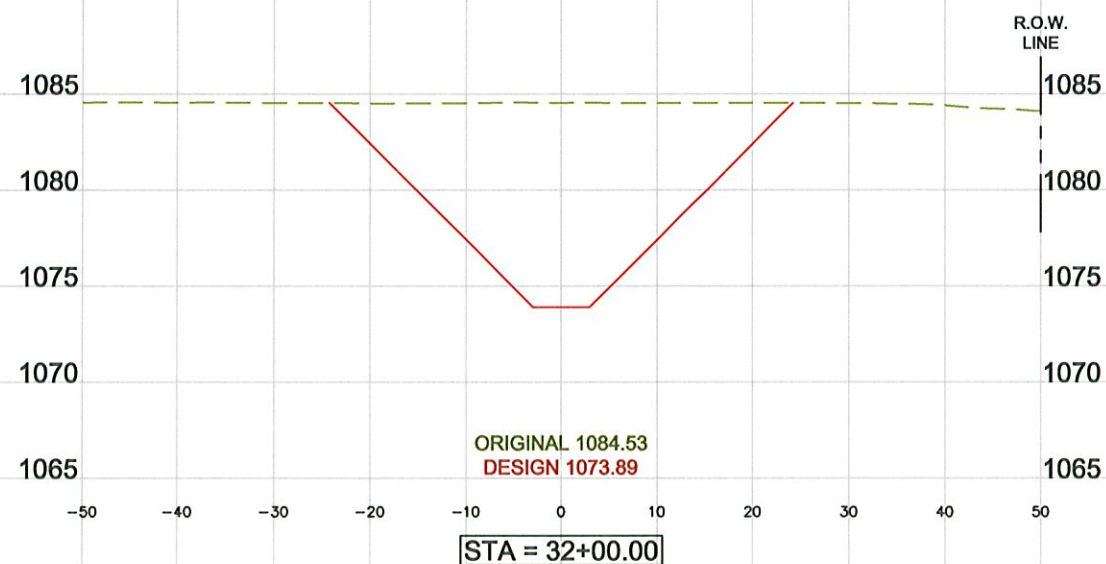
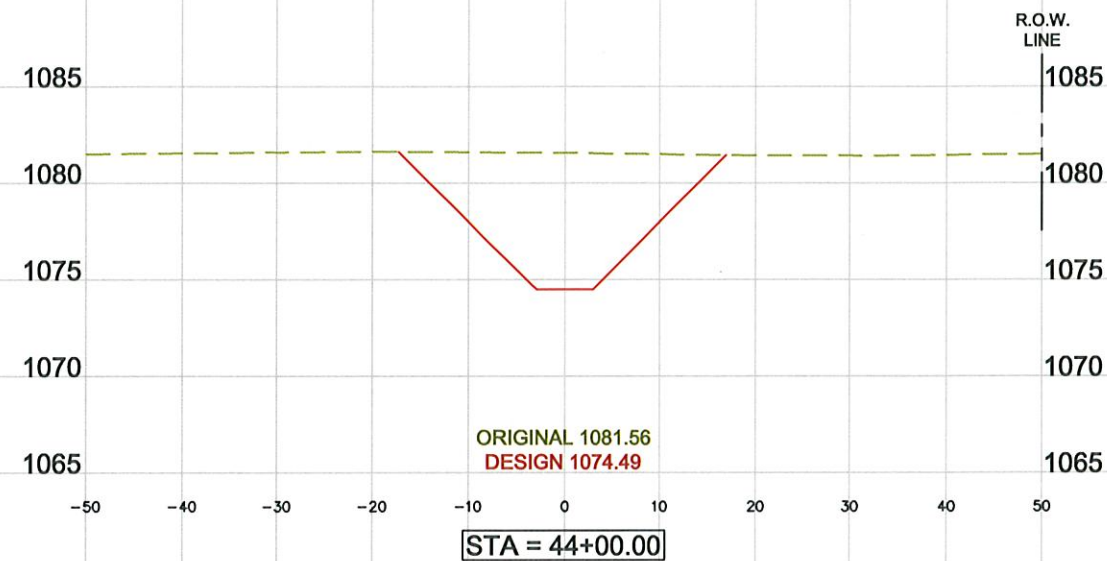
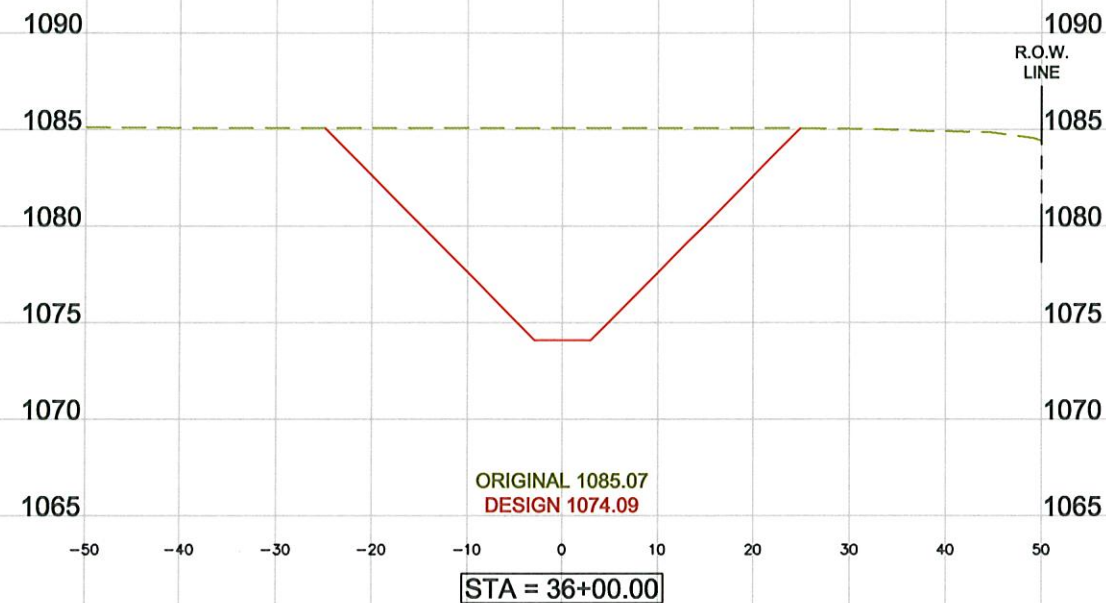
REVISION SCHEDULE		
NO	DATE	DESCRIPTION

PROJECT NO.	13-16118
FILE NAME	16118 CROSSSECTIONS
DRAWN BY	N. KITZROW
DESIGNED BY	B. BLOMME
REVIEWED BY	I. DROESSLER
ISSUE DATE	
CLIENT PROJECT NO.	

TITLE

CROSS
SECTIONS
MAIN OPEN DITCH





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PROJECT

ORTON SLOUGH
DRAINAGE
DISTRICT

WOODBURY COUNTY IOWA

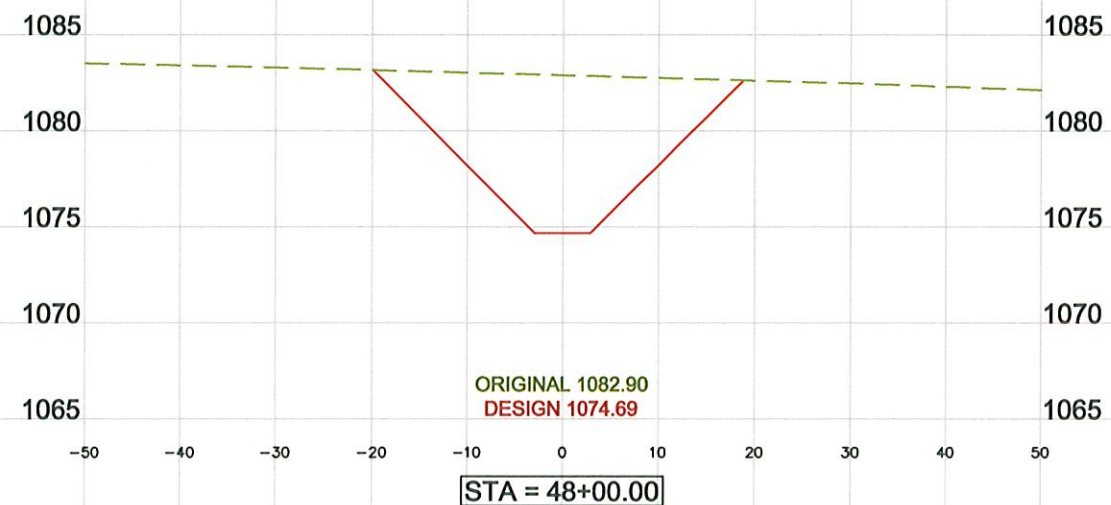
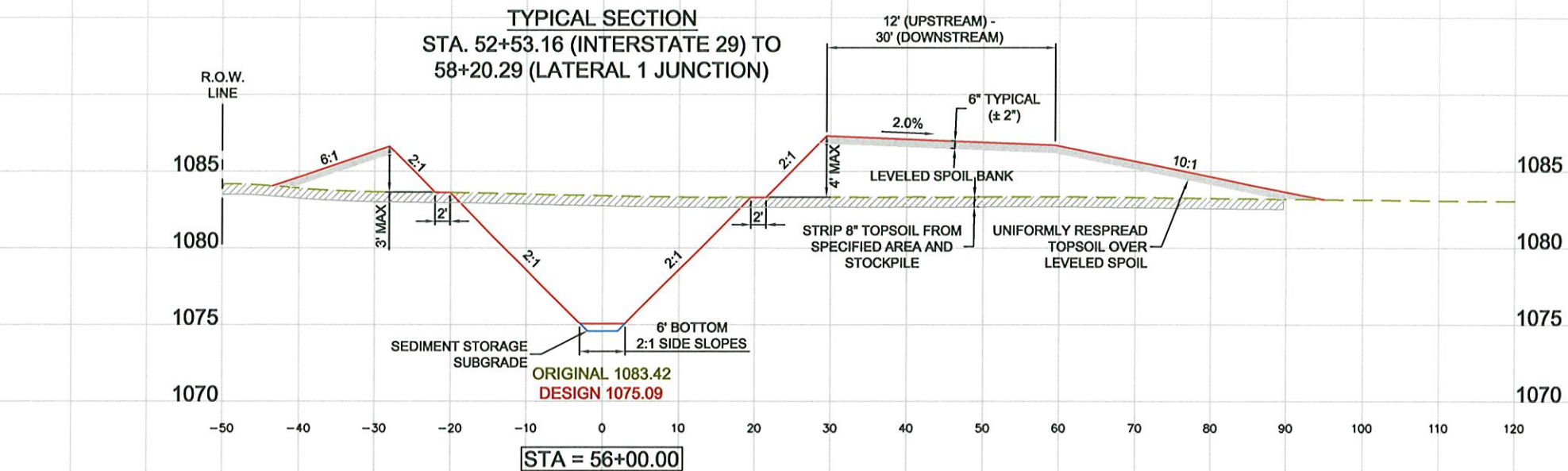
REVISION SCHEDULE		DESCRIPTION
NO	DATE	

PROJECT NO.	13-16118
FILE NAME	16118 CROSSECTIONS
DRAWN BY	N. KITZROW
DESIGNED BY	B. BLOMME
REVIEWED BY	I. DROESSLER
ISSUE DATE	
CLIENT PROJECT NO.	

CROSS
SECTIONS
MAIN OPEN DITCH

SHEET

X.03



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PROJECT

ORTON SLOUGH DRAINAGE DISTRICT

WOODBURY COUNTY

IOWA

REVISION SCHEDULE		
NO	DATE	DESCRIPTION

PROJECT NO. 13-16118

FILE NAME 16118 CROSSECTIONS

DRAWN BY N. KITZROW

DESIGNED BY B. BLOMME

REVIEWED BY I. DROESSLER

ISSUE DATE

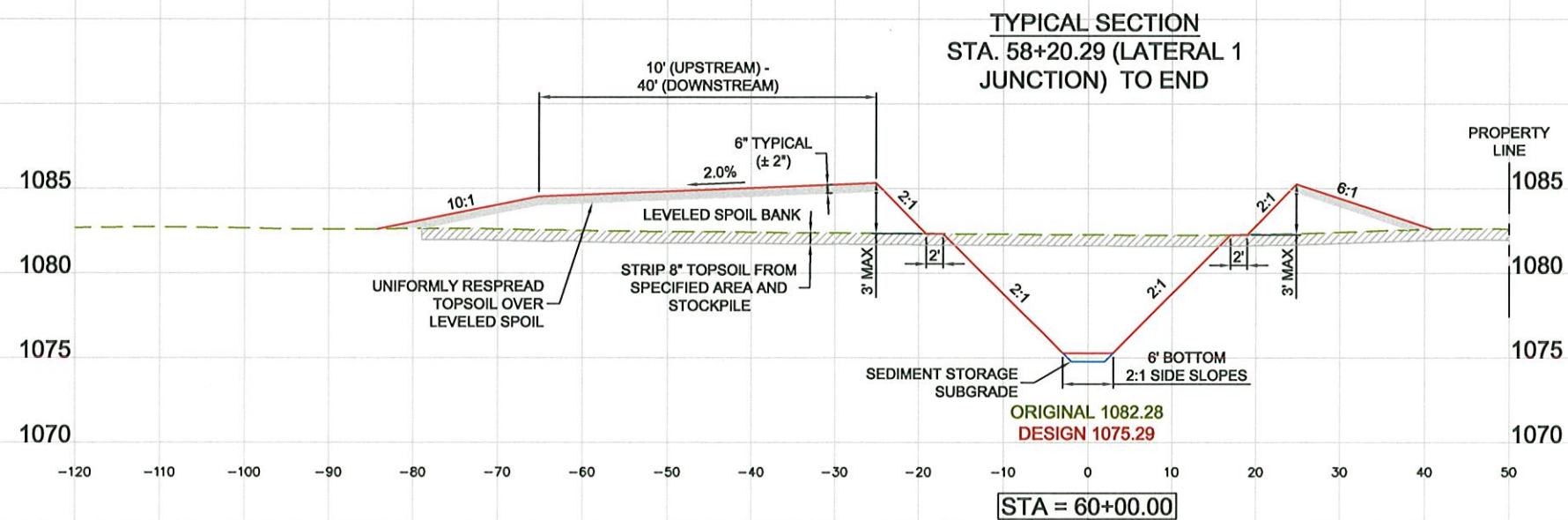
CLIENT PROJECT NO.

TITLE

CROSS SECTIONS MAIN OPEN DITCH

SHEET

X.04



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PROJECT
ORTON SLOUGH DRAINAGE DISTRICT

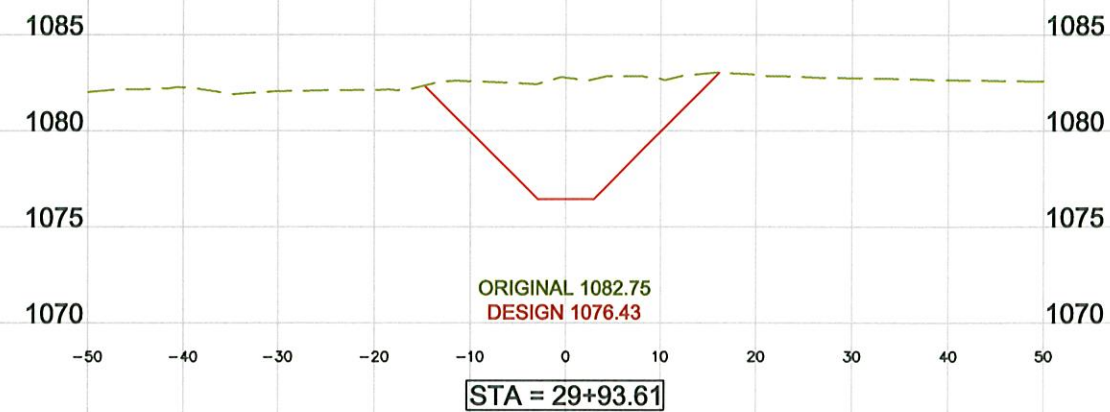
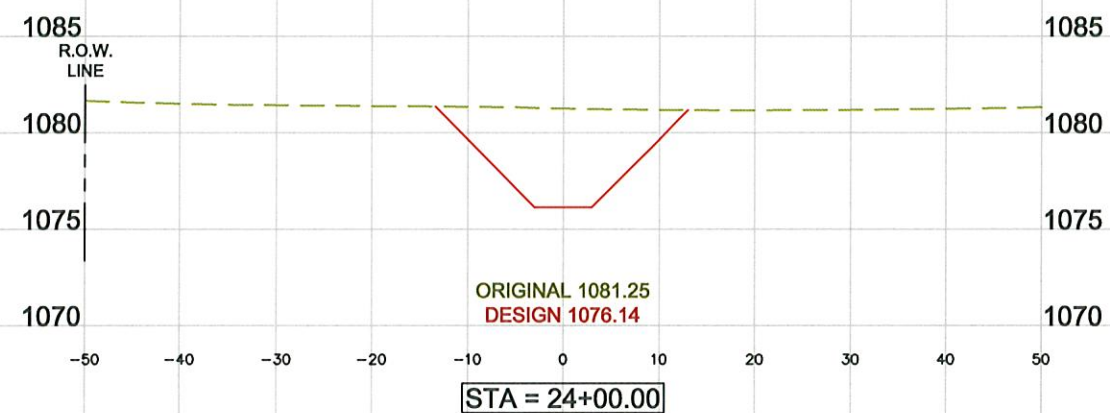
WOODBURY COUNTY IOWA

REVISION SCHEDULE		
NO	DATE	DESCRIPTION

PROJECT NO. 13-16118
FILE NAME 16118 CROSSSECTIONS
DRAWN BY N. KITZROW
DESIGNED BY B. BLOMME
REVIEWED BY I. DROESSLER
ISSUE DATE
CLIENT PROJECT NO.

TITLE
CROSS SECTIONS MAIN OPEN DITCH

SHEET
X.05



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PROJECT

**ORTON SLOUGH
DRAINAGE
DISTRICT**

WOODBURY COUNTY IOWA

REVISION SCHEDULE	
NO	DATE

PROJECT NO.	13-16118
FILE NAME	16118 CROSSSECTIONS
DRAWN BY	N. KITZROW
DESIGNED BY	B. BLOMME
REVIEWED BY	I. DROESSLER
ISSUE DATE	
CLIENT PROJECT NO.	

**CROSS
SECTIONS
LATERAL 1**

SHEET
X.07